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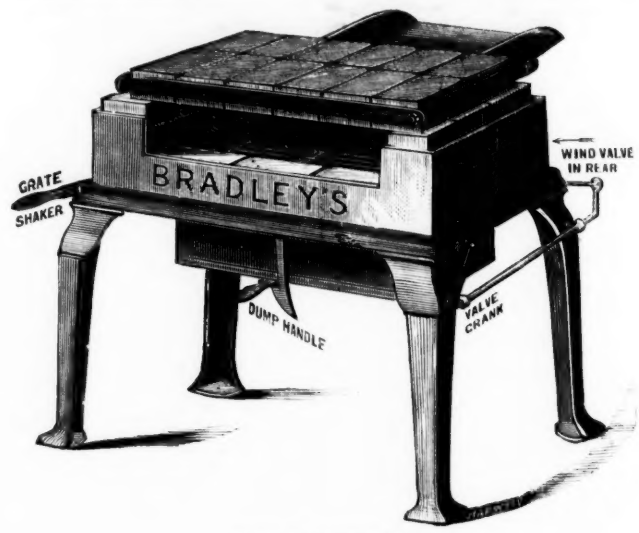
For Sale Everywhere by Newsdealers.

ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

Bradley's Hard-Coal Heating Forges.

In forging tools and small articles, it is essential to have a furnace adapted for the purpose of heating the material to be worked.

Where a drop or other power hammer is used, the pieces to be forged have to be heated very rapidly, and this requires a fire giving out intense heat, as well as of possessing a good body, so that when a fire is put in order it will last for a long time simply by small additions of fuel. The first illustration on this page represents a forge, as now manufactured by Bradley & Co., Syracuse, N. Y., for use with their cushioned hammers. This forge consists of a cast iron box or frame, mounted upon legs, and lined with fire brick. It also has a grate provided with a shaking device, by means of which the fire may be instantly cleaned or dumped. These advantages will be readily understood from the illustration. The top of the furnace is formed by fire bricks, held together by a clamp, as shown. An apron is also provided for holding fuel and facilitating the management of the fire. An air valve is attached at the back and operated by a handle, which puts the blast under perfect control of the operator. There are three sizes of these forges now made. The one here shown represents size No. 3, which has a grate 13½" x 22½", and is intended for heating large and heavy work, also for heating irons for bending and forming. This forge, when desired, can be arranged with opening for heating at the end, instead of the side. No. 2 is the same as the one described, except that the grate is 9" x 14", and is best adapted for heating material for forging hammers. It can also be used for welding. No. 3 has a grate 7" x 9", and is suited for heating or welding light work. Anthracite coal is the fuel intended for these forges.



NEW HEATING FORGE.

An Improved Hand Lathe.

The accompanying engraving shows an improved hand lathe and countershaft, designed by the American Watch Tool Co., of Waltham, Mass., for use in watch and clock factory machine shops. It is 12" swing, and the bed is five feet long.

In this lathe the headstock spindle is hollow and takes self centering wire and stepped chucks which have come into universal use in the above factories, and it also takes any scroll or independent-jawed chuck.

Bearings are of the two-taper kind, and are hardened steel ground true.

The cone is reversed, allowing the front bearing to be braced in the direction of the drilling strain. The ratchet and pawl on the back of the headstock prevent the spindle from turning when loosening the chucks.

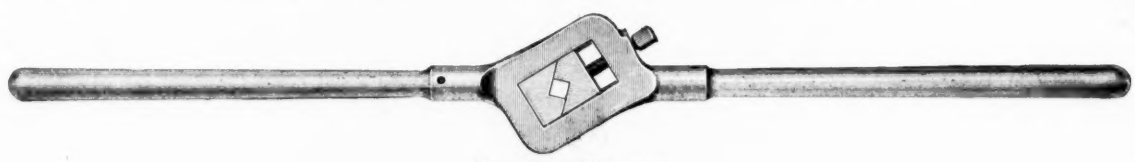
The tail spindle has a long motion, and always the same length of bearing, and is very firmly held, as it passes entirely through the tailstock. Eccentrics are used to bind the tail stock, shoe, etc., to the bed.

The ways are joined by ribs which prevent springing.

The front of the legs is vertical, no part projecting in front of the bed, thus being out of the way, while the rear legs run back to give steadiness.

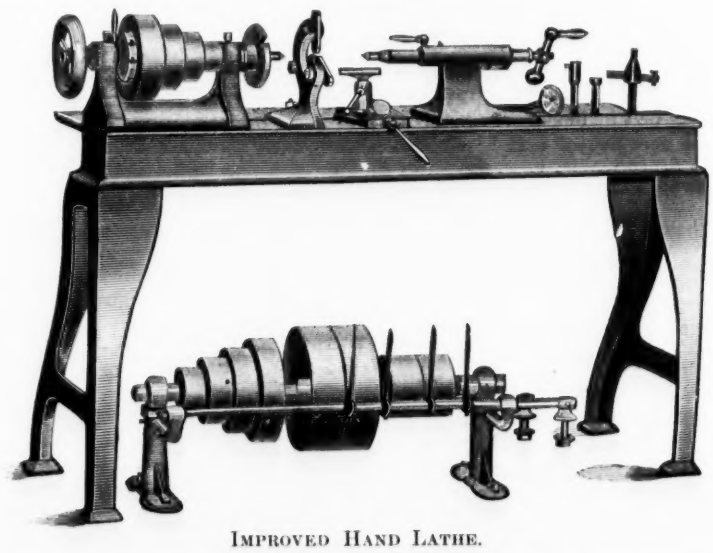
New Tap Wrench.

The tap wrench shown herewith, represents a tool being made by the Morse Twist Drill & Machine Company, of New Bedford, Mass. This wrench is made from a solid forging and has no loose handle, which proves very objectionable by continual wear. The dies are made of steel, tempered, and are adjusted by a screw as shown. The peculiar shape of the dies, besides adding greatly to their strength, also facilitates their removal should occasion require. When desired the dies may be duplicated.



NEW TAP WRENCH

This wrench is a well-proportioned and well-made tool, and is capable of fitting a number of different-sized taps, and holding the taps firmly without danger of tearing off the corners when subjected to heavy strains.



IMPROVED HAND LATHE.

A Business Indicator.

The aggregate earnings of our railroads may be taken as a sure indicator of the aggregate volume of general business.

The earnings of forty-seven of the Western roads making weekly reports, were, for the first four months of this year, $52,931,155, against $46,532,179 for the corresponding period last year, a gain of $6,398,976, or about 14 per cent. For the month of April alone the earnings were $14,727,676, against $11,792,323 for the same month in 1880, an increase of $2,935,353, or 25 per cent. The mileage for April shows a gain of 16 per cent., and the earnings per mile of road were $472 in April, 1881, against $439 in April, 1880.

Many of these roads had to contend with snow up to about the middle of April this year, and then suffered even more severely from floods, thus causing a serious falling off in traffic.

Formula for the Horse Power of Leather Belts.*

BY A. F. NAGLE.

A PAPER READ BEFORE THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

For laced belt

$$HP. = (.55 - .00002157\ V^2)\ V\ t\ w\ C$$

For riveted belt

$$HP. = (1. - .00002157\ V^2)\ V\ t\ w\ C$$

$C = (1 - 10.^{-0.0075 f @})$

$@$ = Degrees of Belt Contact.

w = Width " " in inches.

t = Thickness " " "

f = Coefficient of friction = .42.

V = Velocity of Belt in feet per second.

V becomes a maximum at 92 ft. per sec. for laced belts.

V becomes a maximum at 125 ft. per sec. for riveted belts.

NOTE.—These formulas are upon the basis of a maximum stress of 66⅔ lbs. per inch of width for laced belt, and 121⅓ lbs. per inch of width for riveted belt, each $\frac{7}{32}$ of an inch thick, being ⅓ of the breaking strength of the belt. Weight of leather taken at 55 lbs. per cub. ft.

In my present practice with mill machinery, the question of the power of belts is of constant occurrence; and, in turning to the books upon the subject, I did not find satisfactory answers. For instance, in Samuel Webber's Manual of Power, page 98, are given no less than five formulas, all of substantially the same form as the one given by Mr. Webber himself, viz.:

$$w = \frac{HP \times 5500}{\text{velocity contact in feet}}$$ for single leather belts. This formula, expressed in terms of the diameter and revolutions, becomes

$$w = \frac{HP \times 5500 \times 360}{D^2 \times Rev. \times \pi^2 @}$$; $@$ being the degrees of contact; other notations are well understood. This makes the width vary inversely, as the square of the diameter; and also, inversely, as the simple multiple of the arc of contact, and takes no cognizance of the centrifugal force.

All mathematical investigations indicate that the width varies inversely as the diameter instead of the square; and the adhesion or friction varies as a logarithmic function of the arc of contact instead of a simple multiple.

I turned, therefore, to a recent book by Mr. John H. Cooper, on the Use of Belting, wherein I found a large and valuable

* Our readers who understand arithmetic, but who are unacquainted with algebra, may use any of these formulas by observing—1st, that every letter (including $@$) represents some number or dimension, which (except f) must be found from each individual belt; 2d, that each of these numbers must be inserted in place of its corresponding letter in the formula *and the sign of multiplication* written between the numbers where no sign is expressed in the formula. (In algebra when letters, or letters and numbers, are written together without signs, the sign of multiplication is always understood). 3d, that π (Greek letter pi) = 3.1416, or the number of times the diameter of a circle is contained in its circumference; 4th, that the logarithm of any number and its application may be found by reference to almost any of the engineer's pocket books.

collection of matter on the subject, but no attempt was made to assimilate the same.

I presume that all that is necessary for a complete solution of this problem can be found within those pages, except some mathematical investigations for which we can refer to our text books.

There we have Gen. Morin's experiments, and, later, those of Mr. Henry R. Towne. From this mass of data I have constructed the new formula, which, I think, covers all conditions of belt power; which are its

1. Strength and tension.
2. Coefficient of friction.
3. Degrees of contact.
4. Velocity.

1. STRENGTH AND TENSION.

Mr. Towne's experiments upon leather belts, 3 inches wide and $\frac{7}{32}$ inch thick, are generally accepted among engineers as furnishing reliable data for calculations of other sizes. Reducing to the unit of measure of one inch width, he found the ultimate strength to be—

At the lacings	210 lbs.	100	55	31
" " rivets	382 "	182	100	56
" " solid part	675 "	321	177	100

He determined upon 200 lbs. as the ultimate strength of the lacings, and adopted a coefficient of safety of 3, thus giving the maximum working tension of $66\frac{2}{3}$ lbs. per inch of width, $\frac{7}{32}$ inch thickness.

For a riveted joint this would be increased 82%, or to 121.33 lbs.

I shall use this same working tension in my subsequent calculations.

The strength of leather, like that of other materials, is proportional to its area of section. Denoting the thickness by t, and the working tension by S, the above working tension will be expressed, for laced joints, by $S=66.667\times\frac{3}{7}\times t=305t$; for riveted joints by $S=1.82\times305t=555t$.

2. COEFFICIENT OF FRICTION.

The coefficient of friction f of leather upon iron, Gen. Morin found to be .56 when dry, .36 when wet, .23 when greasy, .15 when oily. Mr. Towne's experiments were made with new, partially worn and well-worn belts upon iron pulleys, and under such conditions as ordinarily prevail in the workshop. He finally determined upon $f=.42$ as a coefficient that could be safely depended upon. It is also a well-established fact that this coefficient is independent of the pressure and surface of contact. In Mr. Towne's experiments, the pressure varied as 20 to 1 on pulleys from 12 in. to 41 in. diameter. In Gen. Morin's, the pulleys varied from $4\frac{3}{8}$ in. to 24 in. diameter, and the width of the pulley was reduced in one case to 60% of the width of the belt.

3. DEGREES OF CONTACT.

The law, according to which a belt transmits force (F) by virtue of its frictional resistance and degrees of contact, is shown by Prof. Rankine to be expressed by the formula $F=S\left(1-10^{-0.00758f@}\right)$ (1), where F=force transmitted, S=working tension, f=coefficient of friction, @=degree of contact.

If we call the expression in the parenthesis C, and substitute the value of $f=.42$, and solving for various values of @, C becomes—

TABLE I.

@	90°	110°	130°	150°	180°	210°	240°	270°
C	.485	.555	.617	.669	.735	.788	.830	.864
%	.66	.75	.84	.91	1.00	1.07	1.13	1.18

A diagram accompanies this paper graphically illustrating this table.

4. VELOCITY.

The velocity of a belt multiplied by the force with which it moves is an expression of its power. When this velocity is great, the centrifugal tension engendered thereby must be considered. Prof. Rankine expresses it as equivalent to "the weight of a piece of the belt, whose length is twice the height from which a body must fall in order to acquire the velocity of the belt." By formula, centrifugal tension $T=\frac{WV^2}{g}$ (2), where W=weight of a unit of length of the belt, and if the cubic foot weighs 55 lbs., the unit of length of one foot an inch wide, and t inches thick, would weigh $W=\frac{55t}{144}=.382t$ lbs. V=velocity in feet per second, g=velocity produced by gravity in a second and =32.2 ft.

With these values substituted in equation (2), we have $T=\frac{.382\,t\times V^2}{322}$ or $.0118615\,tV^2$ (3).

This centrifugal tension acts upon the belt regardless of any tension produced by any power transmitted, and, of course, by so much diminishes its capacity for transmitting useful work. In other words, if S is the maximum stress to be applied to the belt, whatever centrifugal tension there may exist must reduce S by so much for useful work. Or, available stress becomes $S-T$; or substituting the value of T, becomes $S-.0118615\ t\ V^2$, and equation (1) becomes $F=(S-.0118615\ t\ V^2)C$ (4).

The horse power is finally obtained by multiplying the net effective force per second, and width of belt in inches w, and dividing by 550 (the foot lbs. of a H P per second) or $HP=\frac{FVw}{550}$ (5), or by substitution.

for laced belts

$$HP=(305\,t-.0118615\,t\,V^2)\times\frac{V\times w}{550}\times C,$$

or,

$$HP=(.55-.00002157\,V^2)\,V\,w\,t\,C\,(6),$$

and for riveted joints

$$H\,P=(1.00-.00002157\,V^2)\,V\,w\,t\,C\,(7).$$

Equation (6) becomes a maximum when V=92.57 ft. per second=5554 ft. per minute, and (7) when V=125 ft. per second=7500 ft. per minute.

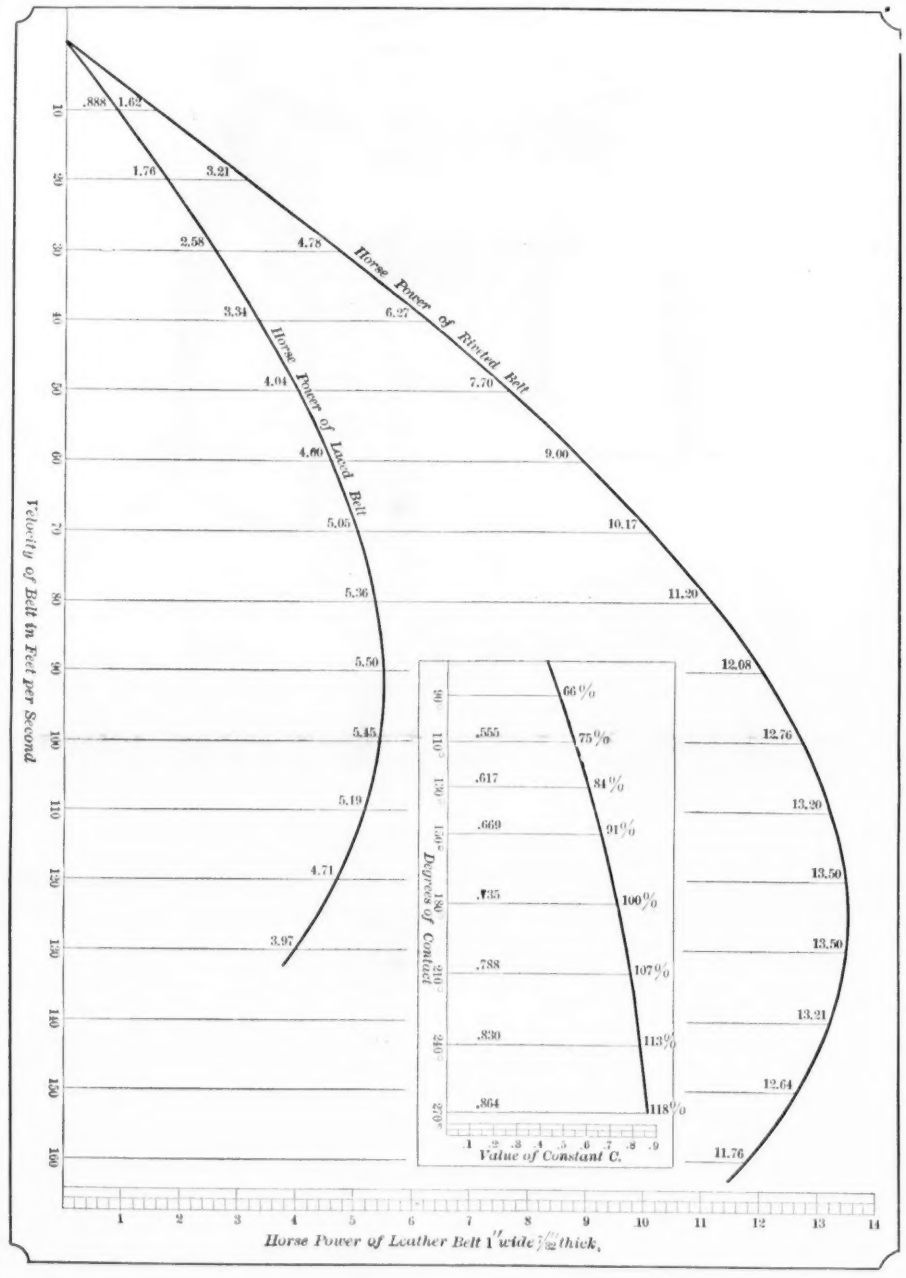
This formula, I believe, contains all the elements that enter into the problem, and I repeat the factors entering into it, so that it may be clearly understood how it is made up; and if any special reasons should exist for changing those factors, it may be done.

Weight of leather=55 lbs. per cub. ft.

Stress upon laced joints=$66\frac{2}{3}$ lbs. per in. width, and $\frac{7}{32}$ in. thick. Stress upon riveted joints 1.82 times as much, which in either case is $\frac{1}{3}$ of the ultimate strength of said joint. Coefficient of friction of leather on iron=.42. Value of C for arc of contact as may be taken from Table I.

I append the following list of belts in use, and the width they should be, by either Mr. Webber's rule or mine.

The data are taken principally from Mr. Cooper's book, the Journal of the Franklin Institute, and some from my own experience. The data are not always as complete as they should be, but I have approximated as nearly to the truth as I could. I have considered the belts as *laced*, and when no thickness was given, such as the circumstances would warrant.



Horse Power.	Velocity in Feet Per Minute.	Diameter of Small Pulley.	Pull of Belt Per Inch of Width—Pounds.	Width of Belt In Use.	Width by Webber's Rule.	Width by Nagle's Rule.	Thickness.
375	5600	5′—0″	98	24″	22″	34″	Double
250	3080	7′—0″	58	48″	50″	28″	4 ply
220	2451	3′—6″	135	22″	98″	31″	Single
175	3179	6′—0″	93	19½″	15½″	25″	Double
175	3629	9′—7½″	55	29″	15″	32″	"
130	2117	5′—10″	113	18″	18″	22″	"
125	3490	7′—0″	82	14½″	8″	17″	"
90	2860	5′—0″	87	12″	10″	15″	"
77	2268	5′—0″	77	14½″	12″	12″	"
45	2000	4′—0″	37	20″	21″	15″	Single
49	2111	6′—0″	24	18″	14″	18″	"
43	1800	5′—0″	44	18″	20″	14″	"
40	2000	6′—0″	37	18″	14″	13″	"
41	1809	5′—0″	42	17½″	12″	16″	"
18	850	0′—22″	116	6″	19″	8″	Double
8	942	2′—6″	40	7″	12″	8″	Single

DISCUSSION.

In reply to a question, Mr. Nagle said:

"The empirical formulas that are given for belts, mentioning the surface of contact, where the surface of contact is a factor, I apprehend are introduced from the fact that the high speeds are usually obtained by small pulleys; that is, a large pulley communicating the motion to a small pulley; thus, of course, losing some of its contact on the small pulley. The empirical formula is an approximation to provide for the angle of contact and the centrifugal force. In that equation both are taken cognizance of mathematically, and co-efficients are substituted for them; so that I think that it meets all practical cases.

MR. ALDEN.—I would like to inquire whether the practical results of the experiment confirm the formula, or otherwise; whether it was found that the formula agreed with the practical results, or disagreed largely.

MR. NAGLE.—There is a very wide diversity in the results of these experiments. In Mr. Cooper's book on belting, there are some experiments made in a similar manner to those of Mr. Webber; and those experiments practically confirm the theory. I can pick out isolated cases from these experiments that confirm the theory; others will not. I have not had time enough to examine it as closely as I will by and by; but I see occasionally a figure that will conform to the theory. You must remember that they are always making so many experiments, producing diverging results, that it is very difficult to draw a conclusion from any one of them.

Trades Unions.

BY F. F. HEMENWAY.

I became awakened last week to an interest in the wants of advertisers in the machinery line. I find a good many advertisements for skilled workmen, and occasionally there is tacked upon one of these advertisements, "No union men need apply."* Probably there is no moral reason—certainly there is no legal reason—why the proprietor of an industrial establishment should not refuse to employ union men. I don't suppose there is a kindred reason why he should not refuse to employ Odd Fellows, or Freemasons, or individual members of any other organization. I don't find anything but the members of trades unions tabooed. There is a reason for all things, and if you should get far enough back the reason for this would be apparent. I don't believe the advertiser has any objection to unionism as an abstract principle. Probably you wouldn't have to get very far back to find that this addendum to an advertisement complete in itself, represented his antagonism to something with which he has come into contact, and to which he has given and from which he has taken, blows. Naturally he objects to taking part, just as you or I would. The union to him means organized antagonism to capital—not mere antagonism in the aggregate, but in a condensed form. If you were that advertiser you wouldn't hire a union man—not if you could get any other. If you were a union man you wouldn't throw the union over for a job—not if you could get another. I wonder if both sides to the controversy ever read, "Put Yourself in His Place." It makes all the difference in the world how you look at a thing.

You can read a great deal about "the identity of interests" of labor and capital. This identity of interest exists to a certain extent, but when you try to spread it out too far it gets thin. There is an identity of interest between the man who buys and the man who sells anything. When a man wants to buy he wants to find a good many anxious to sell the identical thing he wants. If he wants to sell he has an interest in a good many men who want to buy. But the man who wants to buy likes to be the only representative of that class, and the man who wants to sell is pleased when similarly situated. Their individual desires separate at the point of selling dearly

* No such advertisement has ever appeared in the AMERICAN MACHINIST.

and buying cheaply. There isn't enough identity about it to do any harm. There is enough antagonism about it to work a large amount of good. This desire to buy cheaply and sell dearly represents the selfish part of human nature, and the selfishness of humanity makes the world fit to live in. It builds railroads and canals, improves steam engines, and in a hundred ways goes to make things pleasant and comfortable. When the thing to be bought or sold is a certain amount of human exertion, or the exercise of acquired skill the case isn't particularly different. That same selfish desire to buy cheaply and sell dearly still exists, and it continues to work good results. Buying cheaply makes rich manufacturers, and rich manufacturers are a good thing. Selling dearly makes well-kept and contented operatives, which is a better thing. All experience demonstrates that when a man buys a railroad he will get into a combination to increase rates. The identity of interests reaches out so far as the desire to get plenty of traffic goes; but it gets cut short at the other end by the desire to control the price in his own interest.

The party who sends his products to market is interested in lots of competing railroads. He hasn't an overpowering interest in the parties who own them. The sum of the two representative individual desires makes a balance. There isn't any sentiment about it. There isn't a particle of philanthropy in it. It is business. Philanthropy is a distinct branch, and these two representatives may do something in it, but they will establish a separate bureau to manage it. When the man who owns the railroad gets too aggressive the man who is obliged to patronize him will join the Grangers, or the Anti-monopolists. He will unite with other men as weak as himself in hopes that their aggregated strength may bring the single representative to grief. When they become too strong for the single individual, he will buy a couple of legislatures and a Governor, and continues the fight.

* * * * * * *

I've tried to reason up to the theory of trades' unions, without any prejudice, but there is considerable besides theory in the subject.

The manufacturer wants to hire his workmen at low wages. The workmen want high wages; and in this there is nothing wrong on either side. When the employer waxes too strong for the individual workman, he (the workman) unites with others similarly situated. He don't do this from any high-toned sentiment. He does it from pure selfishness. It's a pure business transaction. When this union of individuals makes itself too prominent, the single individual objects. Occasionally, the result is a conflict, in which all parties get injured. It don't seem to make much difference which way you put it. There isn't any law against the organization of trades' unions. There ought to be no such law. There isn't any law against employers objecting to their existence. There ought to be none. Employers tell us that much of the trouble between labor and capital is brought about by union interference. Trades' union advocates tell us that there is generally cause for this trouble. Not many years since, workmen in England and France were subject to severe penalties for refusing to work at a fixed rate of wages. Supply and demand were not allowed to have much to do in settling the matter. It is not so many years since there were some millions of workmen in this country who didn't have any voice in the matter of their relation to capital. There wasn't much satisfaction to any one, except the capitalists, in either of these conditions. How much the existence of such conditions had to do with the organization of trades' unions the philosopher must determine.

There are a great many who have no particular interest at stake, who profess a belief that trades unions are a bad thing, especially for their members; but they never advance any argument, except that of dollars and cents; as if, because a man happened to work for wages, there wasn't anything of, or for him, only so much money, or what money will buy. Suppose the line of argument were shifted to a higher plane: It isn't necessary to get away from a business view of it; but the sole intent of business isn't bread and butter. You can't furnish a body of men, with a certain amount of common sense, by enactment. Sometimes it can be done by fair argument. Suppose, that instead of showing by a formidable array of figures that so much money was lost to workmen during a certain strike, it be demonstrated that they have not gained, or have not honestly contended for some right? Suppose if they have gained, or tried to gain something which was right, it be honestly admitted that a standard of dollars and cents won't measure right and wrong for the workingman any better than it will for the man who don't work? It is just possible that it may not be wise to try and satisfy a workingman with argument that wouldn't be tolerated upon any grounds but that of expediency.

* * * * * * * * *

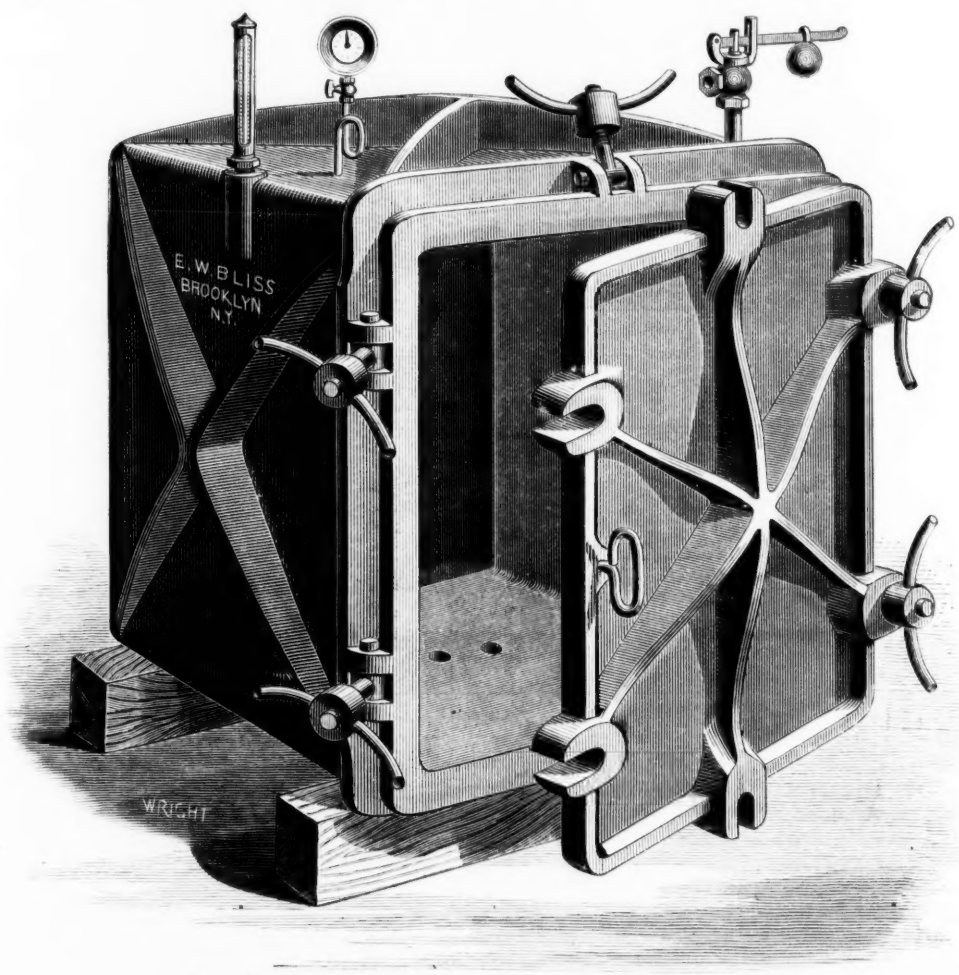
I used to belong to the army of tramp machinists, and once on a time belonged to the union. I don't believe I was "a fool"—not entirely; or "cut my own throat;" or "arrayed myself against capital;" or did any one of a good many other things charged to union men. I don't believe I was "led by demagogues." I have an idea I led myself. I don't believe I led others. I have the same faith that they led themselves. I belonged to the union, and carried it with me through most of the Eastern States, and kept with it through several of the Western States. I don't know that it was particularly a good thing to take along, nor that it was particularly a bad thing to have. I don't think the taking of it along was constructive treason to manufacturers; nor do I think it would have worked material injury to fellow tramps or stay-at-homes to have left it behind. My tramping was like that of the commercial traveler—with something to sell. Instead of a box of samples, of something to be delivered by and by, the sale was for immediate delivery. The price was like that of a good many other things—governed by circumstances. With money in both pockets, the inquiry had considerable reference to current prices. With the bottom of the last pocket apparent, the inquiry didn't get much beyond the prospect of a job.

* * * * * * * * *

If I were to do more tramping, with the same wares to sell, I don't know why I *shouldn't* put a certificate of union membership in my pocket. I don't know any valid reason why I *should* put it in my pocket. If I did take it along, I wouldn't use it to persuade or coerce others who were selling something twenty per cent. better than I had to offer, into selling at my price. If my wares were the best, I wouldn't allow it to be used to lower my price to their standard. I don't suppose I should be asked to do it. If I had individual grievances to settle, I would settle them individually. If I were so unfortunate as to find myself located and subjected to wrong in common with all, I suppose I should make common cause against it. If I was a union man to day, and had nothing but the sordid view that is presented by its opponents, I am not sure that I should not get so leavened as to see wrong where no wrong existed; and sometimes try to make one right of two wrongs. Perhaps I should inquire how it was that those without a particle of practical experience in the matter came to know so much more of my side of the question than I had ever been able to find out myself. I don't believe it would wean me from it by having those who were conscientiously opposed to it perpetually showing me how to make ten cents, by enduring what I just as conscientiously believed to be wrong. If there was no wrong I should want to be convinced of it by fair argument, and not by slurs and inuendoes. If there was wrong I should want to be convinced that there was some better way of righting it than by united effort.

* * * * * *

I used to be a tramp machinist, and in my tramps struck a good many average shops owned by average proprietors. Looking back through some years, I am bound to admit that these proprietors were very fair samples of men. I never found any of them anxious to exchange four dollars in cash for two dollars in work. If I had found such a one, I should have instantly bid him good by. Prospective failure might have seriously interfered with some of the four dollars. I don't think I was ever accused of trying to get rid of four dollars in work for two dollars in cash. I expect they wanted considerable work for little money. I expect I was interested in the money part of the transaction, without strong enough regard to the quantity of work to do much harm. Good wages entice a man into doing a great deal of work. A great deal of work entices the proprietor into paying good wages. There isn't any high-toned sentiment about it, but it works well at that.



NEW STEAM CHEST FOR COOKING FRUITS AND VEGETABLES.

New Steam Chest for Cooking Canned Fruits, Vegetables, etc.

The single illustration upon this page shows a new appliance for cooking canned fruits, vegetables and other food products, which, as a business, has heretofore centered mainly in one city, Portland, Me.; but which is capable of unlimited expansion, especially in our Western States. The whole body of the chest is a single fine loam casting, and is a good specimen of iron foundry work. Two apertures in the bottom admit steam through pipes arranged for the purpose. The brass steam gauge and brass-cased mercury thermometer act together and check each other in indicating the temperature within the chest; while the safety valve, shown in the cut, guards against too great a pressure of steam. The hinges on which the door swings are the same as those which fasten the door when closed; except that the curved slot there used is closed at both ends. In fastening or unfastening the door, a single turn of the wrought iron nut suffices to fasten or release the screw, which is also wrought iron. Cans of fruits to be cooked may be stacked up in a rack on a truck, and truck and contents wheeled in to be left till cooked; when they may be wheeled out at pleasure, saving much time and handling. The interior dimensions of the chest are about 36 inches each way, while its total weight is about 2,600 lbs. The chest is made by E. W. Bliss, Plymouth, Pear and John Sts., Brooklyn, N. Y.

A reader in Tennessee sends us a long article on the explosion of engines, which, for prudential reasons, we refrain from publishing. There are so many *boiler* explosions, and so much alarm caused thereby, that we must decline to excite timid people by notes of impending danger from engines.

Air and water are the great natural disturbers of mechanical energy. The currents of rivers represent a portion of the mechanical equivalent of solar heat expended in raising the masses of water that flow through their channels to the clouds. The winds that propel our ships and wind motors are the product of solar energy also. The chief and most economical means by which the heat, generated in the combustion of fuel, can be converted into mechanical energy for the propulsion of machinery is water, which this heat converts into steam.—*American Miller.*

Preparations are making by the Amalgamated Association of Iron and Steel Workers, to hold its second annual reunion at Beaver, Pa., on Saturday, June 4th.

As a substitute for oil upon oil stones, which often thickens and makes the stones dirty, a mixture of glycerine and alcohol can be used with good results.

A new method of repairing cracks in boilers (invented in Germany), consists in the use of a sort of wedge link—a pair of tapered pins connected with each other in one solid body by a flat wedge.

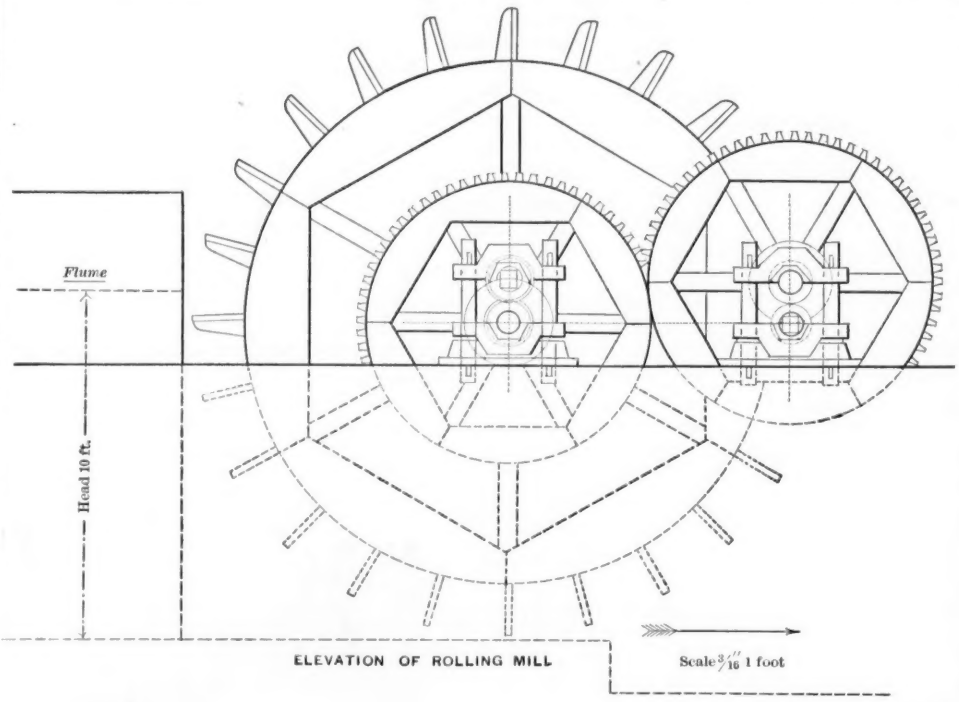
The First Rolling Mill in America.

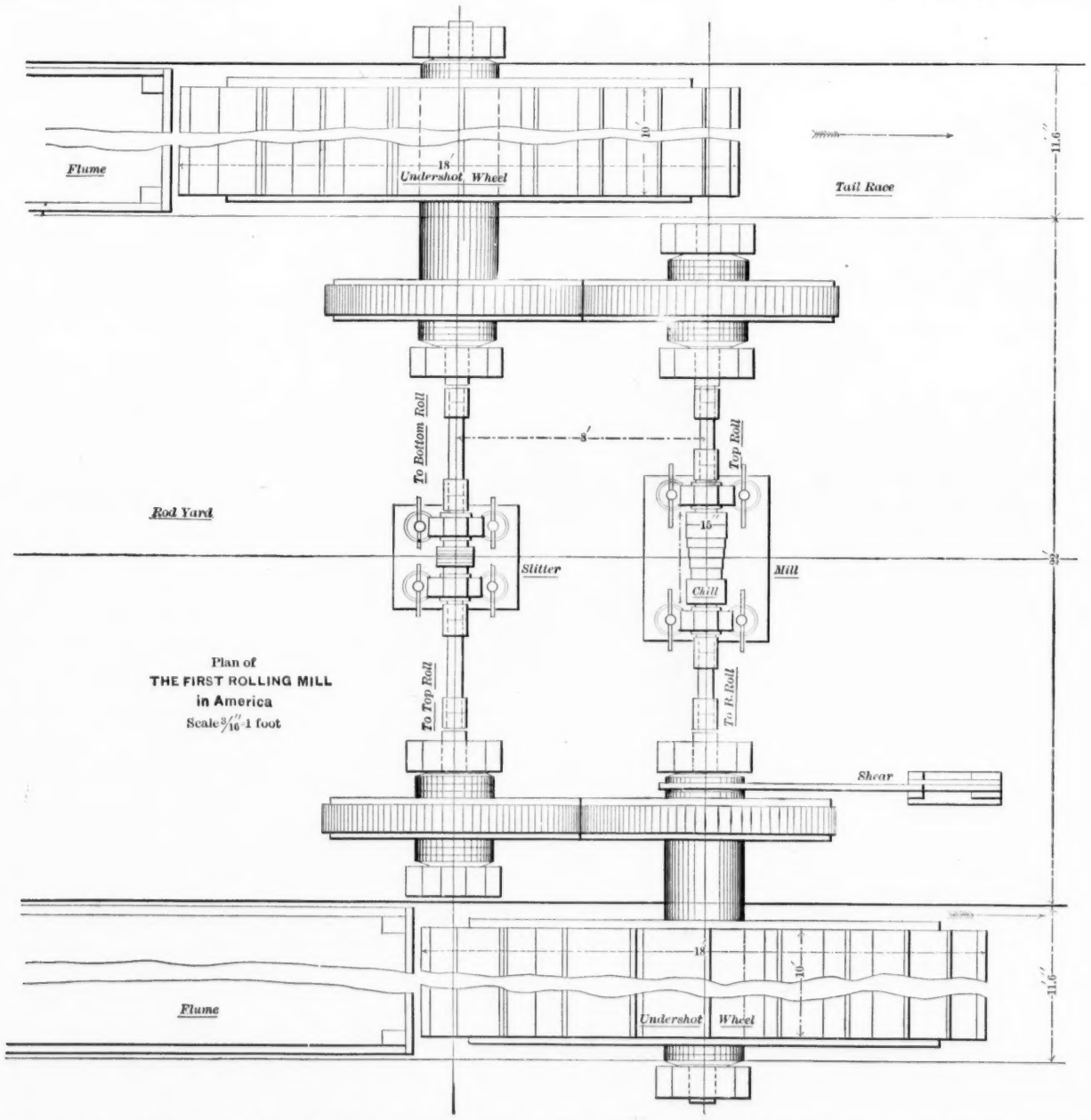
BY WM. H. HARRISON.

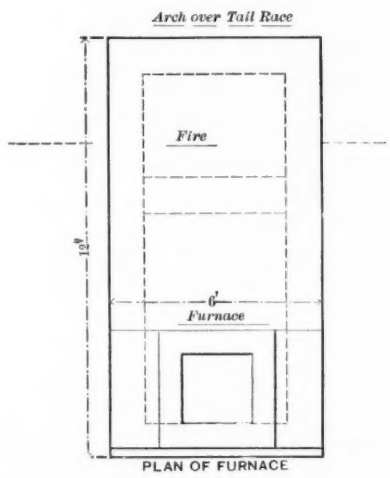
A PAPER READ BEFORE THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

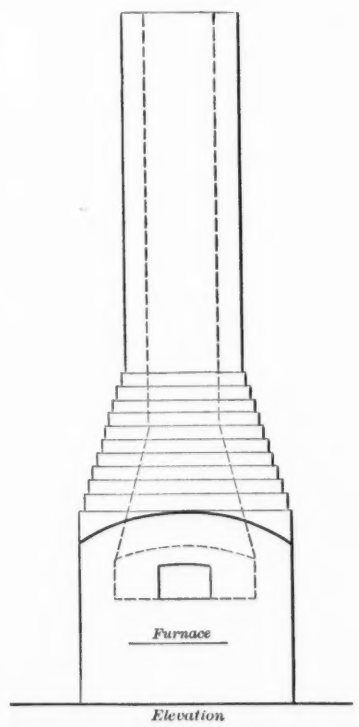
The accompanying drawings are plan and elevation of the machinery of a rolling mill built at Middleboro, Massachusetts, for Peter Oliver, one of the crown judges in the province, and a brother of Andrew Oliver, the Lieutenant-Governor—in the year 1751. They possess no scientific interest, but it is perhaps proper for the representatives of mechanical science in this country, at this, their first meeting in New England, to put on record some account of the work of the mechanics of this section in the olden time.

We have no reliable information as to who the man was who did the actual planning, or the mechanical execution of this mill. The great man who made the money was Judge Peter Oliver, and his name has been handed down to us in the local histories, more on account of his political connections than his knowledge of iron works.









It is probable, from the fact of his being a native of Birmingham in Old England, that he had some knowledge of the processes carried on in that locality. At the time this mill was built there was a law prohibiting the making, importing or using of machinery for rolling or slitting iron in the colonies, in order that the home manufacturers could control the American market. (Subsequent events have somewhat modified the force of this prohibition!) But Judge Oliver, in consequence of his political connections, was granted a special privilege to import and use this machinery. Hence it is supposed that this is the first rolling mill that was erected on this continent. In the spring of 1776, Judge Oliver, along with a good many other of the loyal residents of Boston, went on board a British war vessel and sailed for England. The mill, by confiscation and sale, passed into other hands, and was kept in operation with varying success until 1830, when it was abandoned. The business of the mill was to roll down the hammered bars made at the charcoal forges (one of which was Leonard's Forge, built in the year 1651) into bars about 3″ x ¼″, and to slit them into nail rods of about 5/16″ width, there being no such things as cut nails previous to 1818. There was then the rolling mill and slitter, as shown. The bottom roll of the rolling mill was driven by an undershot water wheel, 18 feet diameter with 10 feet face, at the left hand side, and the bottom roll of the slitter by a similar wheel at the right hand side, 8 ft. further up the stream. The top roll of the mill was driven by a counter shaft and 8 ft. cog wheel, gearing into a similar cog wheel on the right-hand water-wheel shaft, and the top roll of the slitter by a similar gearing to the left-hand water-wheel shaft. The speed could be equalized between top and bottom rolls by raising or lowering the gates a trifle, until the bars would come through without turning up or down. The shear was operated by a wrought iron lever, which was lifted up by a cam upon the water-wheel shaft, as shown in plan. The roll stands consisted of bed plates, as shown, each with four wrought iron posts, five inches diameter, keyed below; the bolsters forming the top and bottom supports for the necks or journals of the rolls were all cast from the same pattern, with a hole at each end, by which they could be slipped over the columns and cobbled up with blocks and wedges, in the manner familiar to rolling-mill men. The rolls were tightened or loosened by driving the long keys at the top of the columns. The rolls were 36 inches long, 15 inches diameter at the ends, which were chilled. The necks were 9 inches diameter. The iron was reduced in four passes from ¾″ x 3″ to ¼″ x 3″. The spindles were of wrought iron 5½″ square. The water wheels, cog wheels and shafts were of wood, with cast iron gudgeons running in timber boxes. The head of water in the flumes was about ten feet, and the speed of the wheels about fifteen revolutions per minute. The iron was received from the forges in bars, 3″ x ¼″ x 8′. These were sheared into three lengths, heated in the furnace with a fire of pine sticks, and then rolled and slitted into the nail rods. In the year 1818 Capt. Zenas Crocker was the manager. About eight men were employed, at about $1 per day; six heats, of about 800 pounds each, were made in twelve hours' running. One pint of rum was consumed for each heat, or more, according to the weather. The value of the forge iron was $100 per ton; nail rods, $120, and nails 12½ cents, or nine pence per pound. The nail rods were put up in bundles of 56 pounds, and the nailers, who had their little shops around in the country, were expected to bring back fifty pounds of headed and pointed nails, receiving "store pay" of calico, tea, rum, molasses, etc.

About the year 1818, Jesse Reed, of Kingston, Mass., brought out the machine for cutting nails, in pretty much the same form as it exists to-day. This did away with the old business of slitting, except for horse-shoe nail rods; but the old mill was kept running, making flat plates from which the nails were cut across the bar, the forge iron being of such good quality as to admit of this treatment. Improvements in rolling followed, the timber fuel got scarce, and the old mill was abandoned and wrecked, so that to-day there is nothing left but the recollections of a survivor, which I have endeavored to put into tangible shape. The drawing was made under the supervision of S. Wilder,

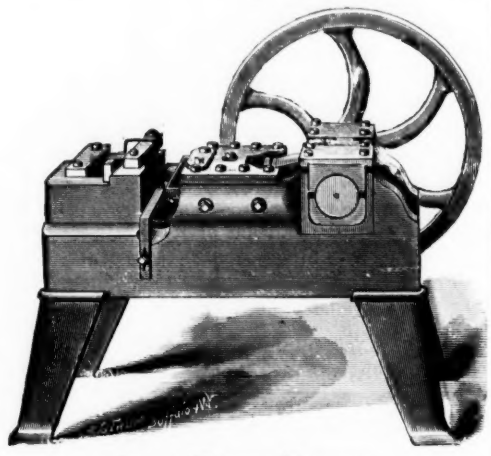
Esq., of New Castle, Penn., a retired iron manufacturer, who worked in this mill in the year 1818, and gave the writer the principal dimensions in feet and inches, and the method of operating. As to whether this mill in the year 1818 was precisely the one built in 1751, Mr. Wilder states that it is likely that there had been some renewals of the wood work, but most of the iron work was the original. It was impossible to break down the mill, from the fact that if a heavy piece or a pair of tongs were passed in, the effect would be, after some squeaking of the timber wheels, to stop everything.

Washer Cutting Machines.

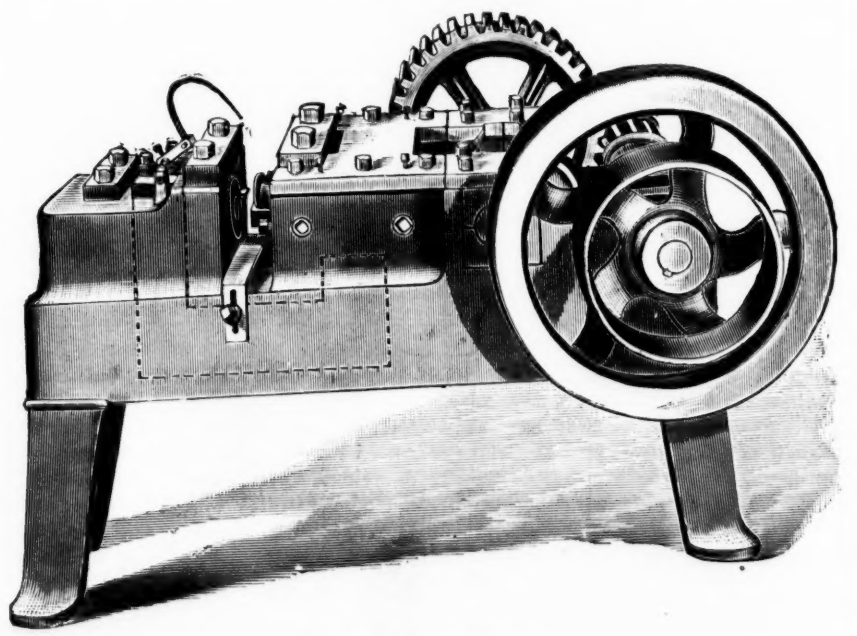
The machine represented by the larger engraving on this page has a capacity for making all sizes of washers on the Nut and Washer Manufacturers' standard list, the largest of which is 4½ inches in diameter and $\frac{3}{16}$ of an inch thick with a 2⅛ inch hole. This machine (the general construction of which will be seen at a glance) makes a washer complete, at every revolution, from cold stock.

It will cut sheet steel flanges six inches in diameter, such as used for wire reels. The punch and die are made straight inside so they can be ground without losing the size. The gauges and pull-off are made of steel. The stroke of the machine is 1⅝ inch and throat is 5 inches deep. The large gear is 24 inches diameter with a six inch face, and the small gear 6 inches diameter. The pulley is attached to an 800 lb. fly wheel and is 20 inches diameter by 6½ inches face. The machine weighs over 5,000 lbs. and requires a floor space 74x28 inches.

The machine represented by the smaller cut will make washers not larger than 2¼ inches diameter. It is constructed upon the same principle as the larger machine except that it is back geared. It can be run to make 100 to 200 washers a minute, weighs about 2,500 lbs., has a throat four inches deep and a heavy fly wheel. These machines are made by York & Smith, Cleveland, Ohio.



SMALL WASHER MACHINE.



LARGE WASHER MACHINE.

LETTERS FROM PRACTICAL MEN.

Explanations and Suggestions Regarding Mechanical Drawings.

Editor American Machinist:

As you have considered it advisable to publish my desultory remarks on a method of copying drawings directly, by means of the blue-print process, so generally used in copying tracings, I will add a few details that may be of use to some of your readers.

The paper we use for drawings is of a bluish-white tint, and thinner than Whatman's sheets or good roll paper; Whatman's, Paragon, and other roll papers, usually have a yellowish tint, and do not answer as well.

We find that shade lines, about $\frac{1}{50}$ of an inch wide, and fine lines, one-third as wide, will copy well. We use the best India ink we can get, and mix it thicker than is usual for ordinary drawings. The average ink can be made to copy well by mixing a little gamboge with it.

Yellow lines copy almost as well as black. For center and dimension lines, a mixture of carmine and gamboge will answer, or vermilion may be used; but the latter settles in the saucer, and requires stirring up before filling the pen.

The paper we use for the blue copies comes in sheets, 28x44 inches in size, and contains considerable sizing; though almost any good white paper will answer.

The solution is spread on the paper with a wide camel's hair brush; a fine sponge does not answer as well.

The drawing and paper are backed up with a thick blanket or felt, and held against the plate glass, in the frame, by screws, through cross pieces against the back board. Springs may answer instead of screws, but in large frames screws will be found more reliable.

The screws should be set up reasonably tight to secure a clear point, and the frame should be moved every five or ten minutes to keep the rays of sunlight perpendicular to the glass. Of course it is understood that the paper must be prepared in a room lighted through yellow glass or by other non-actinic light. We find the paper works better if used within a week from the time it has been prepared, but have secured passable copies from paper prepared a month or more before it was used.

The preparation may be used on tracing paper or cloth, but the latter requires some skill to obtain good results.

A few words about drawings: I think Mr. Thorne has given us the true inwardness of the subject (see issue for May 7, page 5), but I beg leave to differ on one point, and that is rolled tracing.

Some shops, perhaps, may use pencil drawings and ink tracings (which I think is a questionable economy in a place of any size or prospects). In such a case the tracings would be treated as original drawings, and when needed for reference become a nuisance, as it takes considerable time to roll and unroll them, and weights must be used to keep them flat on the table.

Where there are standard sizes for drawings, and most good shops have such standards, there is no great difficulty in keeping the tracings in the bottom of the drawers, and the drawings on top, or vice versa, those more useful for reference in the more convenient position.

A good draughtsman knows how to handle and take care of drawings, as well as a good machinist knows how to handle and take care of files or reamers or taps.

I have yet to meet a good draughtsman who believes that *drawings* should be kept in rolls or rolled in any way. I would extend the same rule to tracings.

I think "Quirk" has made a little mistake in advising the omitting of screw threads, &c., unless the shop is full of trained men. (See issue for May 28th, Page 6). I would rather say *abbreviate* in all possible ways, but make a drawing, with all the necessary "schoolboy explanations"; tell the whole story if possible in more than one way.

In these busy times every man in the shop is not able to read a drawing at the first glance, and you will find many excellent workmen who are very slow at taking in what is shown on the plainest sheet. Some of these men no doubt learned their trades in shops where machinery is built from models or patterns, such as cotton and woolen machinery. Drawings are rarely seen by machinists in these shops. Others were brought up in the "turn this shaft as large as it will go and bore that hole to fit it" way, and they can do good work but need to be told what to do.

What is needed is system in abbreviation as well as system in the shop, or in other work of the drawing room—and each shop will no doubt find some features in other systems which can not be applied in its own with economical results. An hour saved in the drawing room is often wasted several times in the shop.

S. W. POWEL.

South Boston, Mass.

Other Considerations in Mechanical Drawing.

Editor American Machinist:

The amateur draughtsman who has watched the recent discussion, desirous to gain some positive knowledge of what is correct practice, cannot but conclude that there is a deal of "go as you please" about the business; especially must he so conclude when his high notions of the dignity of the calling are disconcerted by the propositions of some of your correspondents.

Admitting that, under certain circumstances, it might be admissible to employ either of the various plans proposed, he is not willing to concede that the ignorance of the machinist is any argument in favor of a subversion of correct methods by the draughtsman. In other words, if "mechanical drawings are made for the mechanic," it manifestly is his duty to understand them, and he is entitled to no consideration at the hands of the draughtsman for his ignorance. Two wrongs never made one right; and it is no more right to compel the draughtsman, who understands his business, to limit his practice to the comprehension of the machinist, who does not understand his, than it is for the manufacturer to discard measuring instruments because his men don't understand their uses. This would be retrograde; the obligation rests with the machinist to learn this essential detail of his trade, but he *is* justified in requiring that drawings shall be in accordance with correct methods; and, if the discussion does not decide what is and what is not "correct," it will at least do something towards it.

The amateur, not wishing to criticise the methods of others, is nevertheless tempted to ask whether it would not be a good plan to make the drawing look as much like the natural object as possible, and whether that would not be correct practice?

Also, whether it is possible to lay down arbitrary rules that will apply to all cases, and whether the effort to do so is not the cause of so many different opinions?

A competent machinist cares little how drawings are finished. All he asks for is an outline and figured dimensions; all the rest is a bother to him, although, as Chordal says, it is the draughtsman's fun.

But the discussion thus far has been with reference only to detail drawings.

Combinations or elevations have had no consideration by your correspondents.

They admit of different treatment from details, affording scope for the artist's skill, and calling for a certain correctness of method—whatever that is. It would seem as if the variety of plans proposed would better apply to combinations than to details.

It is believed, however, that a certain and positive uniformity of method throughout the craft would tend to simplify the practice, and place it within the easier understanding of the average machinist.

This probably will not occur under the present system—or no system—of mechanical training; but further presentation of the subject by your "practical" readers will necessarily elicit many points of value to the craft at large, and especially to the young draughtsman.

J. E. WILSON.

Bridgeport, Ct.

Balancing Engines.

Editor American Machinist:

As there has been a fallacious idea advanced a number of times, by some of your correspondents, in some recent issues of your valuable paper, I will take a moment to call attention to the delusion. I refer to the idea of "balancing," or "aiding in balancing" engines by means of cushioning.

The idea reminds me very forcibly of the man who rode to mill to have a sack of corn ground. After he had received his meal, and was ready to return home, he thought his horse looked rather tired and hungry; and, having a little more sympathetic feeling for these animals than some of the "donkeys" have who have charge of horses sometimes, he compassionately said to his dumb brute: "Hey, Jack, you're tired carr'in' the corn to mill. I will carry the meal back fur you." Then he threw the sack of meal over his shoulder, and mounted his horse with it, and rode towards home rejoicing, thinking that he was carrying the meal, and that the horse was entirely relieved of the burden. Query: which would your correspondents think the heavier—to have the sack placed upon their shoulders, and the man upon the sack; or, the man upon their shoulders, and the sack upon the man?

Cushioning in an engine has a three-fold office, viz.: to relieve the crank pin of a sudden strain or shock; to prevent an unpleasant "pounding," with which ninety-nine per cent. of the engines are blessed; and to fill, or partially fill the clearance space for the purpose of economizing steam. This is the office of cushioning, and nothing more.

Balancing has reference to the engine as a whole. It is impossible to balance engines as they are manufactured at present, but they can be approximately balanced in one of two ways, viz., in the direction of the center line of cylinder, or at right angles to it. The conditions under which the engine is to work must determine in which of these two directions it should be "balanced." (I am obliged to use the term "balanced," although it can only be approximately balanced.)

For instance: A vertical engine on wheels, as a portable, should be balanced at right angles to line of motion. A locomotive, or portable engine, with horizontal cylinder, should be balanced in the direction of the line of motion.

The subject in reference to balancing locomotive engines has been thoroughly dis-

cussed by the writer in *Van Nostrand's Engineering Magazine*, of July, 1880.

The only way a reciprocating engine can be balanced perfectly is by introducing two pistons in one cylinder, moving in opposite directions—or an equivalent design—with the weights of the corresponding reciprocating parts equal. Such an engine, when properly designed, could be perfectly balanced.

But to return directly to the point at issue, let us suspend an engine in mid air by means of a suitable number of chains or ropes. Now, if the engine is perfectly balanced, it may be run in this condition without any oscillation of the engine as a whole. But it does oscillate. What causes it? The piston is started on its stroke. In its motion it has work stored up in it. By and by its motion must be reversed. To reverse its motion, the work previously stored in it must be taken out of it. This is done by the crank pin, or by the steam cushion, or by both. If by the crank pin, the work will at once be transferred to the shaft, then to the bed plate, and as it cannot be transferred any further, it will use itself up in swinging the whole engine. If the piston's motion is checked by means of a steam cushion, then the work is taken up by the same and transferred to the cylinder, and from the cylinder to the bed plate, where it will stop with the same effect as before.

If the piston's motion is partly stopped by the crank pin and partly by the cushion, the final swinging of the engine will still be the same as before, and will be directly proportional to the work stored in the piston, and inversely proportional to the weight of the engine.

Query—Would the engine swing more if you should strike the bed plate at the crank end than it would if you should strike it at the cylinder end?

To prevent this swinging is what is meant by balancing an engine. Simply checking the piston's motion does not balance it, but, on the contrary, *this is the disturbing force.* To balance the engine, we must introduce a force capable of developing an equal amount of work in the opposite direction. This is usually done (attempted at least) in the form of a centrifugal force in a counterpoise. This has a tendency to swing the engine in the opposite direction from that of the piston and its connections, and, *if the two forces are balanced* (that is, equal) the engine will have no tendency to swing, nor to pull up foundations, nor to shake a whole building to pieces, nor to jerk the locomotive from its track, etc., etc.

The man who attempts to *balance* an engine by means of cushioning, is riding his horse with the meal bag on his own shoulders. C. A. SMITH.

Bay City, Mich.

Indicator Diagrams and Boiler Explosions.

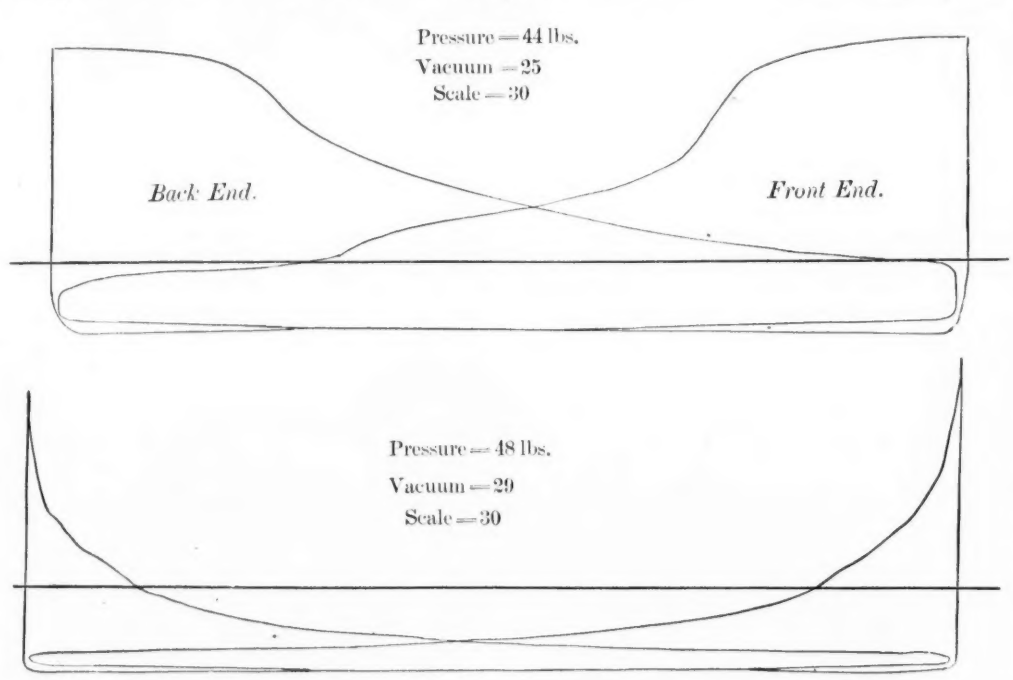
Editor American Machinist:

One of your correspondents called for indicator diagrams, and I send you two pair—shown by the accompanying engravings—taken under every day working conditions, and showing the variation of the load. There is occasionally a day when we have to carry 55 lbs. of steam. The clearance should be $\frac{5}{16}$" for front end and $\frac{3}{16}$" for back end, but the wear of the brasses has probably changed it a little.

The data applying to the above diagrams are as follows: Engine, Corliss condensing; siphon condenser; diameter of cylinder, 28.3"; stroke, 60"; revolutions, 50; area of steam ports, 34"; area of exhaust, 62"; diameter of steam pipe, 7"; diameter of exhaust, 9"; Richards' indicator used; scale, 30 lbs; motion taken from a pin in the end of shaft, connected by a wire.

I would like to hear the opinion of various experts on the best plan for marking points on diagrams. There is another fruitful field for discussion, which has been gone over a great deal, but we are considerably in the dark yet, and that is, the causes of mysterious boiler explosions.

Is not the lever safety valve, or rather the dependence placed upon it, one of the principal causes? I tried one of these valves on a tubular boiler, and found that after the steam commenced blowing off the pressure rose 18 lbs. On a Harrison boiler the pressure rose 13 lbs. The valves worked perfectly free in both cases. A short time ago I heard of an explosion in this State, where the watchman built a fire under the boiler in the morning and went to sleep. The steam got to blowing off so strong, some of the neighbors tried to get into the shop to see what was the matter, but before they succeeded the boiler blew up. The steam gauge showed that the pressure had been so high that the pointer had been carried around until it struck against the pin so hard as to bend the pointer. Another important consideration is the designing of boilers. There are boilers so constructed that under expansion and contraction, some of the joints are transformed into hinges, some have a drum, or extra boiler, on top, and to connect them, an enormous hole is cut out of two or three sheets. Now in what direction are



they going to brace these to regain the strength? Some boilers have braces extending only from the head to the first sheet, as though it had been determined that the circular should be weaker than the longitudinal seams. I saw one boiler with the manhole cut out of the center sheet, and the braces were applied in such a way as to pull the boiler in two at that point.

Waterbury, Conn. W. E. CRANE.

Efficiency of a Forced Draught.

Editor American Machinist:

Referring to an item in a late number on steam heating with a forced draft of the air through tubes, let me call attention to a note by the late Theron Skeel which appeared in the *Engineering and Mining Journal*, October 6, 1877, upon the same subject, with some useful statements of work actually done in practice. Of these results a brief abstract is here given:

Number of heater tubes	122
Diameter of heater tubes	$\frac{3}{8}$"
Length exposed, tubes	20"
Steam pressure	15 lbs.
Diameter blower nozzle	9"
Speed of blower per minute	786 rev.
Air passed " " "	987 cu. ft.
Temperature inlet	78°
" escaping air	142°
Efficiency of surface as compared with simple radiation	3,000 to 1.

Springfield, Ill. P. BARNES.

Some Kinks in Foundry Work.

Editor American Machinist:

How few men, or rather how few moulders there are who have a general knowledge of the foundry business! Even in these days of specialties and special machines, it is for the individual's interest, and for employers' also, that the mechanic should have a fund of general information, especially pertaining to his particular trade or art. The physician is better prepared, and enters the sick chamber with more confidence, to deal with and prescribe the drugs necessary, if he has a general knowledge of how they are made. But how few moulders there are who know how to take a heat off a cupola. It is safe to say there is not 10 per cent. who even have any theory about the matter, and not over 5 per cent. who would be called practical. It is something that is quite simple, but there has been so much written upon that subject that I will keep to my former text of moulding and core making. As much judgment is to be exercised in the making of cores as in any other part of founding. There was an instance, a short time ago, of a certain casting to be made. A great deal of uncertainty was felt about getting a good casting. It had become the dread of all the foundrymen who had the job. It was set down as being the most difficult of anything that had been seen in that town. Everything would happen to those moulds. They would blow a little—sometimes a great deal, scab, shrink, etc.; but scabbing was the principal trouble. The sand was bad; "So say we all of us," was the chorus wherever the poor unfortunate went. One day a fellow came into a shop, looking for a job, and got this piece to make; and as they had no core maker, except a boy 15 years old, he concluded to make his own cores. He made up three or four sets of cores, just as they had made them before; made them *their* way, and cast his piece. It blowed and it "kicked," as the boys call it. Those extra cores were broken up immediately; new ones were made with larger vents, and with more of them; the sand was made more open, and the cores were placed in an oven, where they would surely dry. Result: 100 of those castings have been made since then, and only three poor ones among them. With one the flask shucked, and with two the cores raised; but there has not been the sign of a scab on a casting from that pattern. The way to vent a core is to give all the vent hole you can, and have sufficient sand between vent and metal, so it will not break or burst through. I advocate large vents in cores; they will dry better; the iron will remain quiet; and sounder castings be the result.

Tempering a sand heap is a simple thing to do, and so is putting paint on a house; but you can do some thinking to advantage in tempering sand, and use considerable science in painting a house. A green sand moulder has reason to consider the condition of the weather as much as a farmer. In damp, moist weather, when the atmosphere is heavily saturated, a sand heap will accumulate moisture. Cores will get soft if not placed near a fire, and care should be exercised in wetting sand over night in damp weather. To have a much larger heap of sand than is used each day is really wisdom in a moulder. Keep the daily allowance tempered up. Let the back of the heap get dry, then you can govern the sand's temperature very easily. There are moulds that are made more sure by using sand quite dry for a backing. I have seen more trouble with grindstone troughs, when cast bottom up, than almost any thing else that I was ever shop-mate with. To make assurance doubly sure, face the inside of the pattern to form core with sand of good fair temper about 2" thick; fill in for the body of core your dry sand from the back of the heap, no matter how dry. The less moisture the better; if as dry as ashes it is preferable. You will find that dry sand will pack in tighter with less ramming, for the reason that when the metal enters the mould the heat generates steam from the moisture in the sand used for facing sides and bottom. The sand forming the body of the core, having much less moisture, receives the steam, and, being colder, condenses it, and the dry sand absorbs it. The same treatment should be given the sides of moulds, such as those for lathe beds, planer beds and kettles (when cast bottom up), and in all pieces where there are large pockets in drags or nowels. This treatment will make sand, which is generally considered poor, very acceptable for its purpose.

Toledo, O. FOUNDRYMAN.

The Law of the "Conservation of Force and Energy" Not Maintained in the Action of Gravity Force.

Editor American Machinist:

In Mr. Charles T. Porter's "Treatise on Steam and the Richards Steam Engine Indicator," page 113, is the following most striking and suggestive statement and demonstration, viz.:—

"With *one seeming exception*, motion is never lost, but only changes, back and forth, between atomic and dynamic modes of action, and can always be accounted for in one or the other of these manifestations. This is known as the conservation of force or energy. If motion of a mass ceases, the mechanical equivalent quantity of heat must appear, and *vice versa*.

"This seeming exception is when a weight is lifted against the attraction of the earth. In this case * * * the same heat is converted into work (in lifting the body) that would be in imparting to the body the velocity that it would acquire in falling through the distance it had been lifted, if moving without resistance. The body possesses also the same mechanical energy that it would possess if so moving, and will exert that energy in falling to its original position. It is observed, also, that the body is not warmed when its upward motion is arrested, and that in falling it does not lose heat as it acquires velocity; but that, when its falling motion is arrested without being imparted to another body, heat is produced. This energy suspended under the action of gravity, is called potential energy; a definition which means that we know nothing about it."

Stating in other terms Mr. Porter's meaning,—the body when lifted up and coming to rest, has all the energy of the effort of the lifting motion stored up in it, and yet "it is not warmed;" that is the dynamic energy expended upon the body, in giving its motion and lifting it, is not represented in the body when it comes to rest by an equivalent of atomic-motion or heat, as it should be in the body's changing from a state of motion to rest without resistance, if the law of conservation of force governed its action. Also, in the body's fall, in changing from a state of rest to motion, by its stored-up energy being set free in its fall, there is no loss of heat to represent the motion it acquires:—thus, again disobeying the law of conservation of force.

Mr. Porter's proposition appears true, and another investigation of it confirms its truth. A body placed in space, under the action of

any mechanical or motive force or energy other than gravity or attractive force, if moved by that force, is moved and acquires energy at the expense, exhaustion or consumption of that motive force; and the energy which the body acquires is an exact equivalent, either dynamic or atomic, of that expended or taken from the motive energy. In the action of gravity force this law does not hold good. A body placed in space above the earth, and set free, is drawn towards the earth by the superior attractive force with a uniformly accelerated motion, with the body accumulating energy as the square of its velocity until it is arrested in its motion. Its acquired energy has no equivalent of expended or diminished gravity force. The gravity force attracting the body, and giving to it the acquired energy of its fall, suffers no diminution or change at all. Thus, gravity force does mechanical work without parting with or change of its original force; and, therefore, its force, being unchangeable and inexhaustible, is a perpetual source of energy and power. No other force in nature or mechanism can be employed to do dynamic or atomic work, without expending and transferring to the body or element to which it gives energy an equal amount of its own energy.

Hence, gravity force stands alone—an exception to all other modes of energy; and because of its opposite nature and modes of action from all other manifestations of force and energy, the law of conservation of force, governing all other dynamic and atomic forces, cannot be applicable to or govern the actions of gravity force.

MELVILLE CLEMENS.

New York.

Social Position.

Editor American Machinist:

I am glad to see that apprentices are having attention in your columns.

It would be well for mechanics, manufacturers, and society generally, if more thought were given to shop culture. To make improvement in this direction much depends on the conduct of the apprentice himself. I think there is a false notion entertained, and no doubt this is taken from those to whom the apprentice looks for instruction. An opinion prevails that there is a social sphere to which the mechanic should not aspire; one that is clearly distinguishable, too, from the "Shoddy aristocracy," alluded to by "Apprentice" in your number of May 14th.

We mean that class of society in which moral and mental culture is fostered; and where literary and social clubs are organized and maintained.

Mechanics, as a class, come far short of occupying the sphere their attainments and intelligence would warrant.

But there comes in answer to this, perhaps, the argument used by "Norman," in your issue of the 28th of May: that of "Apprentices usually having slender purses;" and that to go into society requires an expenditure in dress, and other ways, that the apprentice cannot afford. This would have force, if the circle selected were devotees to fashion and extravagance.

Good manners, cleanliness of person and dress are among the requisites to a respectable place in society.

Expensiveness of attire is not at all necessary. As to neatness, I have had occasion to speak of this before; and will only say, now, that it is economy to keep clean, both in and out of the shop.

I have known machinists who could wear a white shirt for several days, and not soil it more than if worn on the street; and such men were very good, and careful workmen, as a rule.

A dirty, greasy machinist does not appear very companionable, however much of the social nature he may possess; thus to be slovenly has a tendency to lower himself in his own estimation.

My day has passed for mingling in the society of the young; yet I could not help feeling indignant the other day, on reading the advertisement of a church picnic, to see a cordial invitation given to "young clerks" to attend. Not a word to young mechanics! Not that I think less of the young man behind the counter, but that I think more of the mechanic, whose attainments are only limited by his energy, and whose sphere of usefulness is infinitely greater.

The American Society of Mechanical Engineers, about which we are now hearing so much, will have much to do with giving character, in the future, to the mechanic. Master mechanics and manufacturers should feel interested. But the main effort must be made by the artisan himself. He should claim his place and prove himself worthy of it.

For the benefit of "Norman" and "Apprentice" I will conclude by telling them how Willie Webb got his start in learning drawing.

Willie was serving his first year. His wages were $2.50 per week, and when the weekly stock of provisions for his mother, grandmother and himself were laid in, he did not have much need of a purse.

Out of this scanty sum Willie subscribed and paid for a work on mechanical drawing, then being published by Blackie & Son, of Glasgow and London. True, the time ran over into his second year when he received $3.50 per week, but the book complete cost $27.00, which was a vast sum for him.

In the meantime a case of instruments was secured at a cost of fifteen dollars more, and, with some little aid from the foreman, Willie became a fair draughtsman, and soon (in six or seven years) became too valuable to stand by a lathe or shove a file.

Willie might have gone on in the same way and secured a fine mechanical library with the money he afterwards spent for cigars; but it seems he did not see so far ahead.

The "purse" has but little to do with it. The will is more than money.

Chattanooga, Tenn. QUIRK.

Foreign Technical Notes.

Translated for the AMERICAN MACHINIST.

A NEW KIND OF STREET LOCOMOTIVE.

Notwithstanding the wonderful developments, reports the *Monit. Ind.*, of steam locomotion on railways and waterways, all the efforts hitherto made to adapt the same power to the purposes of tramway traffic have not met with any encouraging success. Perhaps the most potent difficulty has been in the objection to machines carrying fire along the public streets. If this be so, some recent trials made in France promise to show that this objection has been practically overcome. A French engineer, M. Francq, has put to work a locomotive which is fireless. The construction is much like an ordinary locomotive, except that there is no fire. The boiler is a receptacle of extra strength, and the water contained in it is raised to a temperature of about 395 degrees by the injection of steam at a pressure of 225 lbs. This steam is provided by a stationary boiler at one of the intermediate stations on the line. The fireless locomotive is thus charged with water capable of giving off a quantity of steam sufficient for a moderate journey. Of course, the pressure of steam given off is at first very great, and gradually lessens. But the inconvenience which would arise from this constant change of pressure is overcome by the adoption of a reducing valve, by means of which the pressure of the steam reaching the cylinders can be nicely regulated. There are also ingenious arrangements for condensation and prevention of noise, but these could not be made clear without drawings.

These engines were tried and work from Rueil to Port Marley 5.61 miles, and from Port Marley to Marie le Roi, 2.15 miles; it is, therefore, evident, that these engines are quite capable of covering journeys of length sufficient for tramway work, especially as the engine described draws a train weighing 20 tons.

NEW ABSOLUTE BAROMETER.

La Nature, in giving a more detailed description of this instrument, says that it is made in different forms. There is near the top of the framed board, and sloping somewhat upward to the right, the ordinary thermometer, and close under it a parallel metallic rod, carrying a runner with index, manipulated by means of a button at the top of the frame, working interior mechanism. A little further down is the air thermometer, and still further, a rod (with runner manipulated by a button or foot), whose axis represents the position of the joint. A thread attached to the upper runner traverses the lower one, then passes to a fixed point at the bottom of the frame, whence it hangs vertically, stretched by a weight. A number of barometric graduations are arranged radially under the range of the thread after it passes down from the lower runner.

NEW INVENTION FOR COATING IRON AND STEEL WITH IRIDESCENT COPPER.

This important invention, says the *Revue Polytech*, is the work of Dr. Weil, of Paris. The inventor has found that the best mode of preparing the metallizing bath and the best proportion of ingredients are indicated in the following directions: First, 35 parts of crystallized sulphate, or an equivalent amount of any other salt of copper, are precipitated as hydrated oxide by means of caustic soda or some other suitable alkaline base; this oxide of copper is to be added to a solution of 150 parts of Rochelle salts, and dissolved in 1,000 parts of water; to this 60 parts of best caustic soda, containing about 70 per cent. NaO, is to be added, when a clear solution of copper will be formed.

The object to be coppered is to be cleaned with a scratch-brush in an alkalino-organic bath, attached as a cathode, immersed in the coppering bath, and treated with the usual precautions, when it will become rapidly coated with an adherent film of metallic copper. As the bath gradually loses its copper, oxide of copper, as above prepared, should be added, to maintain it in a condition of activity, but the quantity of copper introduced should not ordinarily exceed that above prescribed as compared with the quantity of tartaric acid the bath may contain. If the quantity of copper notably exceeds this proportion, certain metallic irisations are produced on the surface of the object. These effects may be employed for ornamental and artistic purposes. According to the time of the immersion, the strength of the current, and the proportion of copper to the tartaric acid, the iridescences may be produced of different shades and tints, which may be varied or intermingled by shielding certain parts of the object by an impermeable coating of paraffine or varnish, while the iridescent effect is being produced on the parts left exposed. All colors, from that of brass to bronze, scarlet, blue and green may be thus produced at will. If it be desired to deposit nickel the only modification of the above process requisite is the substitution of precipitated oxide of nickel for the oxide of copper, produced by precipitation as above mentioned. In the above process it will be observed that the introduction of sulphuric acid into the bath is avoided, at least except in such insignificant quantities as may still adhere to the precipitated metallic oxides.

TIE AND CORE METAL.

The improvement in this by a Swedish firm, says *Jernskontoret*, is of the greatest importance, because it assists materially in the combination with plastic materials and concrete in the construction of buildings and pavements, and consists in using roughed or crimped metal sheets in place of the corrugated sheet iron now used, in conjunction with cement, for the formation of floors, pavements, etc. The sheet iron, preferably used, is rolled into folds or corrugations; the sides of which may be either perpendicular or slope inwards, forming wedge-shaped retaining channels for producing a bite upon the material or concrete. To bind, and cause the two to act together, cross wires, at from two to three inches apart, are added when required. The corrugations are dove-tailed, or other shape, and they themselves can be corrugated with smaller corrugations, to give a better hold.

Newly Incorporated Companies.

NEW YORK.

The Shenandoa Cotton Company, Utica; Nicholas E. Kernan, Samuel S. Lowery, Robert S. Williams and others, incorporators; Capital, $200,000. To manufacture and sell cotton yarn, cotton cloth, and cotton fabrics.

Phœnix Oil Company, Buffalo; Wm. H. Gurney, Hugo S. Kiene and John Duel, incorporators; Capital, $30,000. To buy, ship, sell and refine crude oil or petroleum, to barrel and pack the same, and to manufacture barrels and packages for the same.

The Groesbeck and Wright Spark Arrester Company, New York; David Groesbeck, D. Pratt Wright, C. A. Ball, Thomas E. Brown, Jr., and others, incorporators; Capital, $500,000. To manufacture, furnish, let, sell and maintain apparatus and machinery to be used or operated upon locomotives and other engines.

The Pittsburgh Iron and Railway Company, of New York (New York City and Rockland County), Geo. F. Kitchell, Herman E. Long and John L. Davis, incorporators; Capital, $200,000. For the mining of iron and other ores, the manufacture of iron, erection of buildings, and construction of tramways and railways necessary for the proper development of the mines.

The Randolph Furniture Company, Limited, Randolph, Cattaraugus County; Silas Harkness, Zera W. Fisher, Charles Merrill and William A. Sherman, incorporators; Capital, $10,000. For the manufacture and sale of furniture.

The Railway Car Ventilating Company; Joseph A. Sterling, Ernest Groesbeck, Rufus G. Beardslee and others, incorporators; Capital, $500,000. To manufacture, furnish, and sell apparatus and machinery to be used or operated for ventilating railway cars, ships and vessels.

Yonkers Manufacturing Company, Yonkers; Walter E. Lawton, Wm. D. Farwell, Halcyon Skinner and others, incorporators; Capital, $100,000. To construct gas works, to manufacture, buy and sell all kinds of furnaces, stoves, apparatus, tools, and mechanical contrivances for the use and application of gas, steam vapor and electricity for supplying heat, power and light, and for other purposes.

PENNSYLVANIA.

Conshohocken Worsted Mills, West Conshohocken, Montgomery County; Capital, $225,000; George Bullock, James Moir, of West Conshohocken, Augustus Boyd, of Philadelphia, and others, incorporators. For manufacturing worsted, woolen, and cotton yarns.

The Pennsylvania Midland Railway Company; Office, Scranton; Capital, $4,500,000; R. T. McCabe, Scranton, Pa., S. H. Hicks, Scranton, Pa., John McCabe, Scranton, Pa., and others, incorporators. To construct a railroad from a point in Monroe County, Pa., connecting with the North Jersey Railroad Company and the Midland Railroad of New Jersey, to the Susquehanna River, at a point opposite Wilkesbarre, a distance of eighty miles.

ILLINOIS.

Excelsior Furniture Company; Augustus Nelson, John Erlander, John P. Anderson and John A. Johnson, incorporators. For manufacturing, selling and dealing in furniture and upholstered ware. Capital, $25,000, Location, Rockford.

Blue Island Sugar Company; J. W. Dever, C. W. Tremain and Edward S. Hunt, incorporators. To manufacture sugar, syrups and glucose from Indian corn, Chinese cane or any product or vegetable containing saccarine matter. Capital, $50,000. Location, Chicago.

Gem City Milling Company; Wm. S. Warfield, James Woodruff and Henry R. Whitmore, incorporators. Capital, $60,000. To build and operate flouring mills and grain elevators. Location, Quincy.

The Union Smoke Consuming Company; Thos. P. Powers, Robt. A. W. James and John L. B. Lemoine, incorporators. For the manufacture and sale of devices for consuming smoke and improvements in steam boiler and other furnaces. Capital, $500,000, Location, Chicago.

The Independent Barb Wire Fence Company; Charles H. Smith, John Hewett and T. Everett Brown, incorporators. For the manufacture and sale of barb wire fencing. Capital, $500,000. Location, Chicago.

The Chicago Electric Light Company; Joseph A. Sleeper, Geo. F. Averill and Edward L. Barber, incorporators. To buy, manufacture, use and sell any and all tools, implements, machinery, things, appliances and processes for producing or making electric light, or for using or applying electricity in, to, or for all kinds of business objects and purposes, etc. Capital, $1,000,000. Principal office, Chicago.

The Dwight Paper Company; Timothy Dwight, Timothy Dwight, Jr. and C. J. Edwards, incorporators. To manufacture and deal in paper and other merchandise. Capital, $50,000. Location, Pekin.

The Excelsior Gas Light and Manufacturing Company; Luke A. Wilder, Frederick W. Pratt and John A. Elison, incorporators. For lighting streets, roads, buildings, etc., and the manufacture of anything of metal or wood, or both. Capital, $100,000. Location, Chicago.

Terre Haute and Mississippi Railroad Company; E. B. McClure, W. B. Dunlap, D. T. McIntyre, C. W. Powell and Robert S. Cox, incorporators. To construct and operate a line of railroad of two or more tracks, commencing at a point upon the Wabash river in the county of Clark in the State of Illinois, and running from thence in a southwesterly direction upon the most direct and practical line across said State of Illinois to a point upon the east bank of the Mississippi river, in the said State of Illinois. Capital stock, $3,000,000. Principal office, Mattoon, Coles Co.

CONNECTICUT.

The Lyme Silver Plating Company; Capital, $5,000. To manufacture and deal in silver plated goods and planished tin ware.

NEW JERSEY.

New Jersey Silk Manufacturing Company. Paterson; Wright Smith, Samuel Bentole, and John Cozzens, incorporators. Capital stock, $50,000. To manufacture and sell silk goods and fabrics of every kind.

Harrisburg and Western Construction Company, Jersey City; Drake DeKay, John O. Stevens, Geo. T. Chapman and others, incorporators. Capital, stock, $3,000,000. To build and equip railroads and bridges, to contract for, own, buy, sell and convey the same.

The Great Western Construction Company, Ridgefield; Chas. Kohlsaat, V. A. Blacque, E. B. Sackett and others, incorporators. Capital stock, $300,000. To construct and equip railroads in the United States.

The Backus Water Motor Company, Newark. Incorporators, Wm. M. Deutsch, Alfred N. Lewis and Rich. S. S. Cissel. Capital stock, $25,000. To manufacture water motors, dental motors and other implements, rotary actions for church organs, &c.

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NEW YORK, JUNE 11, 1881.

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A Sign of the Times.

One of the most beneficent results of recent efforts in gathering and publishing labor statistics, and opinions of workmen and manufacturers in regard to improving the condition of workmen, promises to be a shortening of the hours of labor. This bids fair to be brought about without a bitter contest between employers and employes. It is evident that a universal reduction of the weekly hours of mechanical labor from 60 to 54 or 55, would not work any injustice to employers. Extra time could be made by those who chose to do so in times of unusual business activity. There is not the least doubt that such a moderate shortening of the hours of labor would prove of inestimable benefit to the workmen themselves.

Inventions and improvements in machinery and mechanical processes have wonderfully increased the comforts and the social condition of workingmen, but unless sufficient time is afforded them, as a respite from labor, to properly enjoy these benefits, the gain will prove much smaller than might reasonably be expected. By ingenious mechanism, one man is now able to do work that formerly required a dozen or twenty men: but with all the increased facilities for production of the necessaries and luxuries of life, no more leisure time is afforded the workman for rest, recreation and the acquisition of useful knowledge through extended observation and the perusal of books and periodicals. There is also no doubt that shortening the hours of daily or weekly labor would promote the welfare of general society, as, by securing to workmen more time for study and healthy recreation, the number of worthy and well-informed citizens would be greatly increased. A respite of an additional one hour a day would enable ambitious and intelligent artizans to improve themselves wonderfully every year. In regard to shortening production in manufactories by shortening the hours of labor, much valuable information is given in the Massachusetts Report of the Statistics of Labor for 1881, recently issued. In summing up the collated statistics, that report says: "It is apparent that Massachusetts, with ten hours, produces as much per man, or per loom, or per spindle, equal grades being considered, as other States with eleven and more hours; and also that wages here rule as high, if not higher, than in the States where the mills run longer time." Expressions were received from most manufacturers of textile fabrics, to the effect that ten hours a day would be better for the manufacturer and operator than a longer time, if it only could be made universal. Many mills are on record as having changed from eleven to ten hours, without experiencing any loss of production.

The Willimantic Linen Company reduced time to ten hours two years ago; and although losing for the first six months, from other causes, have since sustained no loss of product; while wages have remained just the same as while running eleven hours. The report very truly says: "The question of ten hours is not merely, nor even mainly, an economic question. It is chiefly a humane question. Not yet is the mill more than the man: and, if it ever comes to be, then society will begin to die. Therefore, for all humane people, the highest thought concerning even a cotton factory must be the welfare of the operatives."

It is a question whether nine hours work per day would not produce as much, in the best mechanic arts, as ten hours. Even if it would not, the interests of human progress point unmistakably towards a reduction of the hours of mechanical labor to some figure below ten. To accomplish that result, both employers and employes should co-operate. Thus it may be reached as satisfactorily to all concerned as was the change from twelve to ten hours, at a period within the memory of some of our older mechanics.

A mutual agreement, looking to each other's interests, would accomplish the desired result sooner than all the laws that could be enacted.

Pay of Iron Foundry Foremen.

A recent incident has suggested that in too many shops in this country the pay of foundry foremen is altogether too small, in proportion to the work done and responsibility involved. Men in this position must be thoroughly posted on the qualities, tempers and mixtures of sand and iron; and, in fact, the more they understand of metallurgical processes generally, the better they will succeed in doing the work assigned them. More money can be wasted in the iron foundry than almost anywhere in the machine business. In general machine work, it is a question whether the foundry is not the best paying department in the whole business, while the best pattern work and the best machine work possible are useless without good work in the foundry.

One of our correspondents writes us:

"As a rule $1,000 a year in this section of the country is considered good pay for a foundry foreman who has devoted the best years of his life to learning the business; in my opinion $1,500 would not be too much."

The fact is, proprietors everywhere should see the wisdom of being willing to pay special prices for special skill. A case in point is found in the remark of a manufacturer not a thousand miles from this city, who pays one man (not in the foundry, however) a salary of $6,000 a year, that for his part, so long as he could make two thousand dollars profit for every thousand dollars salary paid by him, he had no objection, constitutional or otherwise, to paying as large salaries as men had it in them to earn.

Shop Experience with Boys.

Bright boys, as apprentices in machine shops, if properly managed, prove profitable to employers. But if they are condemned for every failure or mishap, it is useless to look for favorable results.

In a foundry adjoining a machine shop, where we at one time put forth our efforts in machine construction, several boys were employed. Some were apprentices, while others helped the moulders and cleaned castings. Among the latter was one bright youngster whom we will call George, who seemed to take more than the usual interest in his work, and devoted his leisure time to the investigation of methods and processes about the foundry. One day we stopped near him, noticing that he was absorbed in thought, and inquired what was the trouble. "Oh, sir," said he, "I have been thinking for a long time that I would like to go into the machine shop and learn to be a machinist. I wanted to ask you before, but have kept waiting for a better opportunity." "All right, George," we replied, "we will give you a chance to learn the trade." "Do you think that I could get along?" he asked. "Well," we remarked, "we will try you, and see what kind of material you are made of."

The boy was taken into the machine shop and placed in charge of the best foreman in the establishment, who remarked that we would get sick of our bargain—but we did not think so. The dusty, dirty foundry suit was thrown aside for a suit of overalls and a jumper, and George reported for duty the next morning. We put him upon a small lathe first, not believing it the best policy to put what we considered a valuable apprentice at work wiping grease, or upon a drill press or bolt cutter, at first, as is customary in many shops. Three years is almost too short to include all those *extras* which we had to go through during our own apprenticeship.

George got along very nicely, and learned very fast, so that after awhile we directed the foreman to put him upon a new Sellers screw-motion planer which we had just purchased, together with some other new tools. George looked very timid when he took hold of the work, and we told him that he must be very careful in running the new planer, for it cost a great deal of money.

George said, "I don't know how I shall ever repay you for your kindness to me, and I will be so careful in my work that I hope you will have little cause to regret the favors you have shown me." All went well for a few days, but the foreman insisted that George would ruin that new planer by "wiping the head off;" and sure enough when we entered the shop one day shortly afterwards, there stood George by his planer with a very long countenance, and the head of the planer was, as the foreman had said, "wiped clean off." We looked at George, then at the planer. He made an attempt to speak but we told him that we did not wish to hear anything he had to say; and as we turned away in search of the foreman the tears started from George's eyes and ran in rivulets down his cheeks.

When we met the foreman he said, "There, didn't I tell you he would do it; you have too great confidence in boys. When you have had as much to do with them as I have, you will think differently." We told him not to reprimand George, and ordered a new head for the planer, paying for it, as if it was through our experiment that it was broken, and, therefore, it was not right to make the concern pay for it. We went down the shop to where George and his broken planer were and listened again to his pleading to be heard, and told him that we did not wish to talk with a boy who promised so much and performed so little. "Oh, sir," said George, "I tried to be so very careful that I broke that planer through mere carelessness. I see quite plainly how it occurred. I went to raise the head high enough to admit the piece of work under it, and did as I supposed. I then made it fast, set the tool and started the planer, when 'rip she went', breaking the head as you now see it. I would have given anything in my possession rather than have that happen. I guess it hurt me nearly as much as it did the planer." Here the poor fellow again gave way to his grief, "If you will only give me one more chance," he pleaded, "I am sure that this lesson will never be forgotten, and I will never again allow myself to be careless." We told him how great was the damage done, and how he had broken his promises, adding that he should take another just such a planer standing near the original, and finish the same piece of work that he had undertaken.

The foreman laughed at us and predicted an equal result, but his prediction never came true. George has now nearly completed his apprenticeship. He attends a night school, where he is gaining high honors through his rapid advancement. He has not broken any more planers or spoiled a job since his sad experience referred to. His lesson was well remembered, and the boy in whom the foreman failed to see anything which would indicate such talent, as would develop into an able mechanic and engineer, has now convinced all who know him that he will some day fill an honored position among the engineers of the world.

The proprietor has given us the assurance that when George has finished his apprenticeship, there will be a place for him as foreman of his works, and we consider that a very few years' experience in that capacity will prove that he has ability to fill a higher sphere.

Reward of Special Skill.

It would be a curious study to note the number of manufacturing establishments which owe the greater part of their success to the skill of one or two men, who are employes and not owners. It would be an equally curious study to note the treatment such men receive in the shops which are thus built up by them.

Instances are not few in which the general reputation and business of a shop have taken their start in the success of a machine or series of machines designed by some man whose pay on Saturday night, often far too small, is the sole measure of appreciation vouchsafed to him. Instances have been known in which proprietors who have grown rich in money and reputation from the work of such men, have systematically made it a business to sit down on them, and appropriate the mechanical credit which is their due, not less thoroughly than their superior busi-

ness abilities enable them to reap the financial harvest.

It is pleasant to know that in the long run the knowledge that such is the custom in a particular shop gets abroad, and the bright young men who would otherwise be willing to look for promotion in that shop, either leave it to set up for themselves, or never enter it. It is equally pleasant to know that there *are* shops where such men are appreciated, and that these shops are usually among the most prosperous in the country. In such shops the breeze of promotion is always blowing. Every man feels that his future rests with himself, and that the shop is big enough to develop his ambition to the full. Good men, who have vim and ideas, naturally gravitate to such shops, and the proprietors somehow never fail to find room for them. Such concerns, managed by business men on business principles, are typical shops of the highest order, uniting in the best degree mechanical ability and business tact with the capital that these qualities in combination never fail to create.

A grocer in Western Pensylvania writes asking us to publish some effective method of killing rats, either by trapping them or poisoning, so they will not die on the premises. The query suggests that here is a good opening for inventors. Numberless mechanical contrivances are patented every year for purposes less useful. As the pressure of other duties has prevented us from posting up on mechanical rat-trappery sufficiently to enable us to do justice to this correspondent, we mention his plight to give the cue to those whose vocation it is to discover "long-felt wants," and to fill them, "so they will not die on the premises".

Literary Notes.

CALVERT'S MECHANIC'S ALMANAC AND WORKSHOP COMPANION, for 1881. Containing in addition to the usual matter of an almanac, practical, technical and industrial knowledge for artisans and handi-craftsmen. Published by John Heywood, 11 Paternoster Buildings, London, England; represented in the U. S., by T. Gardner, 78 Lewis street, New York City.

This almanac is of special value to persons generally engaged in mechanical engineering, building, constructive, decorative, artistic, manufacturing and kindred operations.

The directions for the examination of water by tests or re-agents are of special value to persons using large quantities of water for various processes. Some of our friends who are puzzled over screw cutting will do well to examine the rules and tables for that purpose contained in this book.

Questions & Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.

(1) J. B. K., Nashville, Tenn., asks: 1st. What is the correct rule for obtaining the horse power of an engine where you have the diameter of cylinder and length of stroke? *A.*—See page 3 of the AMERICAN MACHINIST of May 14, 1881; also answer to question 6, in our issue of May 28, 1881. 2. What is the correct rule for making the calculation for setting a lathe with a "compound" gearing to cut a screw? *A.*—Divide the pitch of thread to be cut by the pitch of the feed screw, and the quotient will be the proportional number or the proportion between the revolutions of the spindle and lead screw. Then using good judgment, select at random any gear for the mandrel, and multiply the number of teeth in it by the number of teeth in the smallest gear selected for the compounded pair, and the product by the proportional number already found, and divide the last product by the number of teeth in the largest gear selected for the compounded pair. The quotient will give the number of teeth in gear to be placed upon the lead screw. The first trial may not give a quotient which will correspond with any of the gears belonging to the lathe, but will enable the lathesman to select gears which upon the second trial will come out right. Where there are no screw cutting tables for compound gearing furnished with the lathe, it is necessary by trial to establish a basis of gears to calculate compound gearing for cutting threads.

(2) H. S. Renovo, Pa., writes: We want to get up a triangle to strike the hour of the night to be heard within the distance or a circle of a mile in a small town. Now what will be the proportions of a triangle for this purpose, and should it be of round or square steel? We want to make as much noise as possible. Should it be tempered, if so, in what? It will be placed about fifty feet in the air, and we want to strike it with a clapper from the floor of the shop. Do you think it would be better to strike with a sledge by hand? *A.*—We have known of a number of experiments with triangles and would say, that every one that we have been acquainted with for the purpose described was a failure. If you make a triangle, it should be of round steel and bent in the shape of a circle, in order to produce as great a vibrating area as possible, and approximate to the shape of a bell. We recommend that you use a bell instead of a triangle, as a greater volume of sound can thereby be produced for the same expenditure of money, and the tone will be far more pleasant. The bell should be struck by a hammer upon the inside.

(3) J. G. B., Fremont, O., writes: 1. I have a steam gauge which has a broken glass over the dial but there are none of the pieces out. Is it dangerous or injurious to use it while in this condition? *A.*—Steam or water does not enter the gauge, therefore there is no pressure and consequently no danger. The glass should be renewed, however, to protect the delicate works of the gauge from injury by rust or dust. 2. I have an engine which I wish to remain idle for about a year. What would you advise me to coat it with to keep it from rusting? *A.*—For the inside of cylinder and valve seat, use the following: tallow, 1 lb., rosin, ¼ lb., and beeswax, ¼ lb., mix and apply warm. The foregoing protects the surfaces and may be removed at any time by the application of heat For the bright work apply lime water (whitewash). 3. Is any person that has a repair shop allowed to make repairs upon machines that are marked patented, and machines that are not marked patented? *A.*—Any person has the right to repair patented articles, but must not make any new parts which are secured by a valid patent. Many articles are marked patented upon which the patents are worthless. Before making any new patented parts of a machine, we would advise you to investigate the validity of the patent, in order to see if you are running the risk of a lawsuit in making such parts. Machinery that is not patented may be built and repaired by any competent person.

(4) D. B. D., Fort Wayne, Ill., writes: Your answer to I. P. M., in your issue of April 16th, is in some places beyond my understanding. You say the cross-section area of the metal in the shell is (14x12x2x⅜)=126 square inches. What am I to understand by "cross-section area of the metal in the shell," and why do you multiply by 2 in this case? Do you mean the area of the end of the shell, that is 50x3.1416x⅜ ÷ 144 to find area in square feet, if required? *A.*—The cross section area of the metal in the shell is a section cut through the longitudinal axes of the shell—showing a section of metal the thickness of the plate and the length of the shell, which, as stated above, is 14 ft. long by ⅜″ thick, there being two sides, or top and bottom, we naturally, having found the area of one side, which is 14x12x⅜ = 63x2 to give the entire amount of metal cut through, which is 126 square inches as stated in our answer.

(5) A. S. P., Paterson, N. J., asks: Is it necessary in making a horse shoe magnet to harden it all over or only at the ends? Would it be better to polish it, part way up from the ends, or only the faces? *A.*—Harden at the ends only, and polish one-quarter the way up.

(6) A. E. S., Joliet, Ill., asks: Will you please give very brief directions for making a small row boat of paper? *A.*—The manufacture of paper boats is a special business, carried on by parties in this State. The method of procedure is something after the following: A block or mould of the entire boat is first made, and upon it are placed strips of paper in layers glued upon one another by a peculiar water-proof glue or cement until the required thickness is obtained. It then undergoes a thorough baking, so as to harden and bind together the entire shell of paper; the block or mould can only be used, of course, for one type or model of boat.

(7) D. H., Camden, N. J., asks: What is the best way to proceed to cut a square double threaded screw, 2 to the inch and ¼″ pitch. *A.*—First cut one thread the requisite pitch and depth, and then mark two teeth, one of them in the change wheel on the lathe spindle or the first driving wheel; and the other in the tooth that meshes with it in the second or driven wheel. Now, by slipping the second wheel out of gear endwise and without turning it, revolve the change wheel that drives it one-half a revolution, and then push the second wheel into gear again, which will bring the spaces uniform on the screw to be cut. You are then ready to cut the second thread, which completes the operation.

(8) L. O. C., Sedalia, Mo., asks: Please tell me which side of a globe valve should be next the pressure coming from the boiler, the under or upper side? Some say the under side, on account of packing valve stem with steam on; some say the other. *A.*—The pressure should always come against the bottom of a globe valve pressing the valve against the screw. The reasons are that when the valve is closed, the steam does not exert a pressure upon the packing, or tend to burn it out. It may also be renewed with a pressure upon the valve. Steam will also pass more freely through valve in entering from the under side, besides the valve is more safe, and will wear much longer.

Business Specials.

50 cts. a line for each insertion under this head.

Wanted—Special Machinery to manufacture. American Machine Co., Cuyahoga Falls, O.

Dies, Punches and Special Tools, manufactured by H. H. Coles & Co., 446 N. 12th St., Philadelphia.

Foot Power Machinery, for workshop use, sent on trial if desired. W. F. & John Barnes, Rockford, Ill.

Presses & Dies. Ferracute Mach. Co., Bridgeton, N.J.

Steam Engines Indicated and Examined. Power Measured. W. H. Odell, P. O. Box 274, Yonkers, N.Y.

Wood Engravings of Machinery and Tools. Satisfaction guaranteed. Chas. Murray, 58 Ann St., N.Y.

Special Notice.—Owners and managers of large establishments throughout the country will find information of positive value in our 75 page illustrated pamphlet, entitled "Useful Information for Steam Users." It contains data on the care and management of Steam Engines and Boilers and Rules for Engineers and Firemen. Sent for 25c. in P. O. Stamps. The J. N. Mills Publishing Co., 165 Broadway, New York City.

Special inducements offered to clubs. "Extracts from Chordal's Letters" in book form, now ready. Cloth. 320 pages. Less than 5 copies, $1.50 by mail, each, postpaid. American Machinist Publishing Co., 96 Fulton Street, New York.

J. C. Hoadley, Engineer and Expert, formerly of Lawrence, Mass., has opened an office at 29 High St., cor. Federal, Boston, Mass., where he will be pleased to receive old and new friends.

A New Treatise on Steam Engineering, Physical Properties of Permanent Gases and of Different Kinds of Vapor. By John W. Nystrom, C. E., 8vo., cloth. Price, $1.50, also A New Treatise on the Elements of Mechanics, Establishing Strict Precision in the Meaning of Dynamical Terms. By John W. Nystrom, C. E., 8vo., cloth, price $2.00. Mailed by E. & F. N. Spon, 446 Broome St., New York City, on receipt of price.

Manufactures.

Hillsboro, Mo., wants a woolen mill.

London, P. Q., wants a cotton factory, a hosiery mill, and a button factory.

Milltown, N. B., parties have contracted for the erection of a cotton mill at that place.

B. & J. W. Belcher, Chicopee Falls, Mass., will erect a new iron foundry.

J. H. Smith & Co., of Athens, Tenn., are going to erect a foundry and machine shop right away.

Quincy (Ill.) Milling Co., H. R. Whitmore, president, has broken ground for their eight-run new-process flour mill.

The Anniston (Ala.) cotton mill company propose to build a new mill of the same capacity as the present one.

Jackson, Miss., Little Rock, Ark., Conyers, Ala., Rome, Ga., and Wilson, N. C., have good prospects of having cotton factories in the near future.

French & Ward, Stoughton, Mass., will build a machine shop in connection with their new knitting mill.

Three new machine shops are to be started in Indianapolis, Ind., this summer, if the necessary tools can be procured.

Webster, Camp & Lane Machine Co., Akron, O., are making rapid progress with the extensive addition to their works.

The Baldwin Locomotive Works made 517 new locomotives last year. They have orders on their books for 574 locomotives to be delivered in 1881.

A cotton factory at Union Springs, Ala., is now a fixed fact. The capital for a factory of twenty-five hundred spindles is already promised.—*Boston Commercial Bulletin.*

The Elyria Screw and Tap Company, Elyria, O., employ 51 hands, and have run day and night for the past three months. At present they are running but 11 hours per day.—*Cleveland Trade Review.*

H. L. Shepard, Cincinnati, O., reports that it is impossible for him to keep up with his orders. He has had to hire a new building 120x56 feet, three stories. Has also started a foundry to make his own casting.

R. W. Gardner, Quincy, Ill., has doubled the capacity of his governor works, and is putting in new tools as fast as they can be obtained. When completed will run 120 hands.

Quincy (Ill.) Lumber Co., have commenced on their new mill, which is expected to be one of the best, with latest improved machinery, on the river. They have contracted for a piston valve engine.

The well-known mechanical engineer, Moses G. Wilder, of Brooklyn, has recently accepted the position of Superintendent of the works of the Fuller Electrical Co., 44 E. 14th Street, New York.

The remnants of the machinery saved from the fire at the works of the Douglass Machine Co., Warren, O., have been removed to Sharon, Pa., where operations have been resumed.

The number of manufacturing and industrial establishments in Indianapolis is 801, with 14,482 employes, and an annual production amounting to $31,500,000.—*Indianapolis Mechanical Journal.*

The Gray Iron Company has increased its capital to $50,000 and is constructing a large building for foundry and machine shops on land of its own on the corner of Erie and Kingsbury streets.—*Chicago Industrial World.*

Jones & Laughlin's American Iron Works, Pittsburgh, Pa., employ in their rolling mill, chain and bolt factories, foundry and machine shops, and at their blast furnaces and coal and coke works, about 3,500 men.

The Spuyten Duyvil Rolling Mill, at Spuyten Duyvil, New York City, is about to go into operation. It will make steel rails and fish plates.

It is proposed by leading men in Staunton, Va., to establish a rolling mill, nail factory, machine shop, and an establishment for the manufacture of car wheels. The company is to be incorporated and operated on a capital of $500,000.

Abendroth & Root Mfg. Co., have just put in two boilers, 120 horse power each, at the Balbach smelting works, Newark, where the explosion occurred which has attracted so much notice recently all over the country.

The rolling mill at Atlanta, Ga., has been forced to suspend by the failure of the Citizens' bank. Its operatives, four hundred and fifty in number, have attached all the material and machinery to pay their wages for April.

E. M. Miller & Co., Quincy, Ill., are building an addition 80x100 ft., five stories high, to their already large carriage factory. They have contracted with Smith, Hill & Co. for engine and machinery. They intend heating their establishment by steam.

Abendroth & Root Manufacturing Company, 28 Cliff St., New York, have just sold three 175 H. P. steam boilers, to A. Smith & Sons Carpet Company, New York, making 1800 H. P. sold by them to this establishment during the past 12 years.

A company has been organized at Nashville, Tenn., with $250,000 capital, who have purchased a site upon which to erect a foundry for manufacturing stoves, hollow ware, and miscellaneous iron and brass castings.

The new factory of the Willimantic (Conn.) Linen Company, the largest of its kind in the world, covers a ground space of 820x174 feet, and contains 122,000 spindles. Twenty thousand spindles are now running.

Subscriptions are nearly completed for the erection of car works at Toledo, O. It is expected that the new works will commence operations August 1, with two hundred men and the most improved machinery.—*Cleveland Trade Review.*

Wallace & Sons, Ansonia, Conn., have contracted to supply the Rapid Construction Co., six thousand miles of compound telegraph wire. It will take a million and a half pounds each of copper and steel wire. They will erect an addition to their shops 200 feet square.

Grant & Bogert have decided to locate their machine tool works in Flushing, L. I., having secured six acres of desirable land with water and railroad facilities. Brick has been ordered for a shop 300 by 45 feet, with an additional wing 45 by 45 feet, for the blacksmith shop.

Wight & Powell, 25 Hermon Street, Worcester, Mass., began March 1st to manufacture machine tools, and are setting up their first lot of lathes. They are now getting out a heavy 18″ swing lathe, with 6 ft. bed, weight, 2,300, and expect to follow soon with a 22″ and 26″ lathe and 25″ planer.

Pullman's Palace Car Company has commenced the erection of car repair shops at St. Louis, not far from the union depot. The building will be about 125 feet square, one story in height, and it is expected to be in use before August. It will be used in making repairs on the cars used on the railways centering at St. Louis, going west.—*Railway Age.*

Morgan, Williams & Co., are the leading manufacturing concern in Alliance, O., says the Chicago *Journal of Commerce*, and one of the largest manufacturers of steam hammers in the United States. Indeed, at the present time they are actively engaged in enlarging their premises, by the erection of buildings of a permanent character, which will increase their capacity for turning out work to three times their present ability. When these are completed and in full blast they will have the largest works of the kind in America.

The Putnam Machine Company, Fitchburg, has closed a contract with a California railroad for the largest order for railroad tools ever taken by the company. The order includes engine lathes, double-headed driving-wheel lathe, one driving-wheel lathe, one car-wheel borer, one 13-inch stroke slotting machine, one 150 ton wheel press, and one 300 ton wheel press, a 14-inch stroke shaping machine, two goose-neck drills; bolt cutters, one 100 horse-power steam engine, six Putnam forges, and many smaller tools.

The new Brush-Light Electric works, says the *Cleveland Leader*, are situated at the corner of McHenry and Mason streets, near the Cleveland & Pittsburgh railroad. They are built entirely of brick, and are very substantial. The main building is 200x160 feet inside the walls and one story high. This building is to be mostly used as a machine shop. The great width of the building makes necessary two rows of pillars to support the roof. Adjoining the main building is the other arm of the "L" in the shape of which the works are built. This structure has a frontage of 600 feet and is fifty feet wide and one story high, like the rest. It will be occupied by the blacksmith shop, which is next to the main building, the foundry, the engine room, boiler room, furnace room and room where carbons are made. There are five other buildings, a pattern shop, a carpenter shop and three chemical and carbon houses. The foundation for another structure is being laid east of the main building. The works, when put in operation, will employ about five hundred men, and it is estimated that it will have cost half a million dollars to start the three hundred horse power engine which is now in position.

Machinists' and Engineers' Supplies.

NEW YORK, May 26, 1881.

Trade does not fall off as it often does upon the approach of warm weather. Prices as a rule are very steady, and many kinds of staple goods scarce. The Worcester (Mass.) firms of C. Whitcomb & Co., manufacturers of machinists' tools, and Rice & Whitcomb, manufacturers of presses and dies, have been united under the name of the Whitcomb Manufacturing Company, Alonzo Whitcomb proprietor.

Bradley & Co., Syracuse, N. Y., offer their new forges, without brick, as follows: No. 1, $30; No. 2, $45; No. 3, $60.

Kirk & Merick, Oswego, N. Y., have issued a 16-page pamphlet on their chemical compound for treating cast iron (Kirk Flux), which will be sent free to any one wishing a copy.

Iron and Metal Review.

The pig iron market is devoid of any feature of interest. Quotations are No. 1, $24 to $25; No. 2, $22; Gray Forge, $20; Coltness, $23.50; Glengarnock, $22.50; Eglinton, $21.50, and Gartscherrie $23. Manufactured iron from store remains on a basis of 2.5c. a pound. Steel rails at mill are selling at $56 to $62, and iron rails $48 to $50. Old T rails have sold to some extent at $26 to $26.50. Wrought Scrap is quoted at $30 for No. 1 from yard.

The metal market is not particularly active. Ingot Copper can be had at 18¾c. to 19c. for Lake; Straits, Australian and Billiton tin, are all quoted at 20c. Lead is selling at 4¼c. for common and 4¾c. for refined; Western Spelter sells at 4¾c. to 5c., and Silesian for 5¾c. to 5½c.; Sheet Zinc 7c.; Antimony 14¼c. to 14½c.

WANTED

A mechanical engineer and draughtsman of 25 years experience, both in America and Scotland, and who has a moderate amount of capital, will shortly be willing to take a position in a machine shop as partner, or to co-operate in starting a new concern. Address BOX 14, AMERICAN MACHINIST.

First class machinist, understanding printing press machinery and capable of superintending a shop, may address, with references, Manufacturer, care AMERICAN MACHINIST, New York.

A good machinist wants employment. Address, "Methusaleh," office of this paper.

Pattern Maker.—Wanted a first-class pattern maker who understands laying out and making gears, and the work of a general jobbing shop. Apply, with references, to John James & Co., La Crosse, Wis.

Wanted.—Situation as foreman in machine shop doing general business. Thorough mechanic. Thoroughly understands drawing. 15 years experience. Had control of 50 men. Address Louden, American Machinist Office.

Wanted.—A first-class Draughtsman. Good designer on engine work and general machinery. Address, with reference, stating salary. Robt. Wetherill & Co., Chester, Pa.

The advertiser wishing to organize a company for the manufacture of a first-class automatic engine, desires to correspond with a mechanic capable of acting as foreman. Address P. O. Box 1042, Batavia, N. Y.

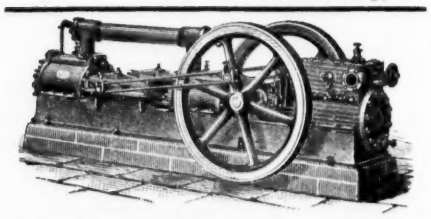
Situation wanted as Foreman by a Machinist; has had experience as Foreman on all kinds of machinery and gun work, both forging and finishing. References furnished. Address W. X. Z., Providence, R. I.

Reliable and Practical Mechanical Engineer and Draughtsman, of 20 years experience, desires position as Superintendent of Machine Works. Address, J. Wadsworth, No. 76 Second St., Brooklyn, E. D.

MACHINERY WANTED.

150 Feet of Second-hand Shafting.
1 Chasing Mill to grind sand.
1 Blower.

Address **C. E. STAUFFER,**
E. Stroudsburg, Pa.



STEAM PUMPS, AIR COMPRESSORS, Friction Hoisting Engines, Vacuum Pumps and Condensers, General Machinery, Steam Engines. Capacity to bore cylinders 110 in. diameter, and turn Fly Wheels of 24 feet.

The Norwalk Iron Works Co.
SOUTH NORWALK CONN.

FOR SALE.

A 34-inch Engine Lathe, with screw and back gear. Bed 8 feet, turns 3½ feet in length. Swings 21 inches over carriage. Has compound rest, swinging to any angle. Accompanying tool are countershaft, 24 inch independent 4 jaw chuck, 18 inch independent 3 jaw chuck, large face plate and stationary rest. Detroit build, and in first-class repair. Price, $500.00 on board cars in Detroit.

DETROIT IRON & BRASS MFG. CO., Detroit, Mich.

FOR SALE,
AT MIDDLETOWN, CONNECTICUT,

A valuable manufacturing property with water power, machine shops, foundry, forge shop, office, store houses, etc., one dwelling house, barn, and 2½ acres of land. Said premises are within 20 minutes walk of the post office and depot. For particulars, enquire E. ACKLEY, Esq., Middletown, or of E. G. PARKHURST, of the Pratt & Whitney Co., Hartford, Conn.

FOR SALE CHEAP.

Foundry, Machine, Blacksmith and Wood Shops, with paterns, tools and machinery complete. Will be sold separately or as a whole. Address
F. M. ROBINSON, Conneautville, Pa

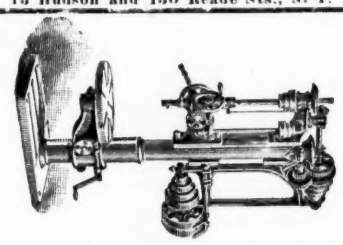
HOUGHTON'S BOILER & TUBE COMPOUND,

PURELY VEGETABLE.

LOOSENS SCALE & PREVENTS ITS FORMATION.

SAVES FUEL, LABOR AND REPAIRS,

HOUGHTON & CO.
15 Hudson and 130 Reade Sts., N. Y.



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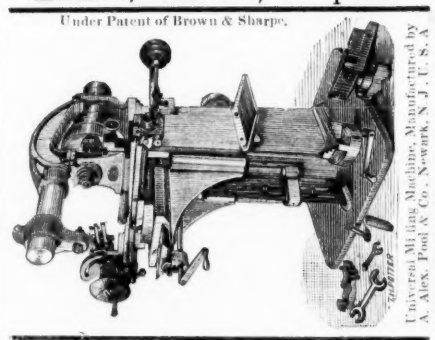
NEW HAVEN, CONN.

Lathes, Planers, Shapers.

Under Patent of Brown & Sharpe.



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(Formerly Wm. Cooke, successor to Cooke & Beggs)
6 Courtlandt St., New York,
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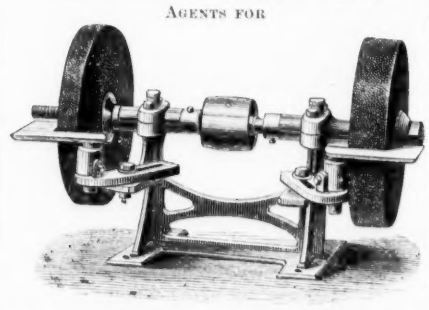

The Lehigh Valley Emery Wheels and Emery Wheel Machinery.

Our wheels possess superior cutting qualities, combined with great durability. Eureka Plow, Polisher and Automatic Knife Grinders.

FRICTION CLUTCH PULLEYS AND CUT-OFF COUPLINGS,

JAS. HUNTER & SON, North Adams, Mass.

LEHIGH VALLEY EMERY WHEEL CO.

LEHIGHTON, PA.
Manufacturers of Emery and Corundum Wheels and Grinding Machinery.
COOKE & CO., 6 CORTLANDT ST., NEW YORK AGENTS.

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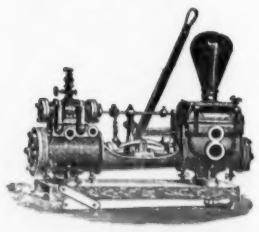

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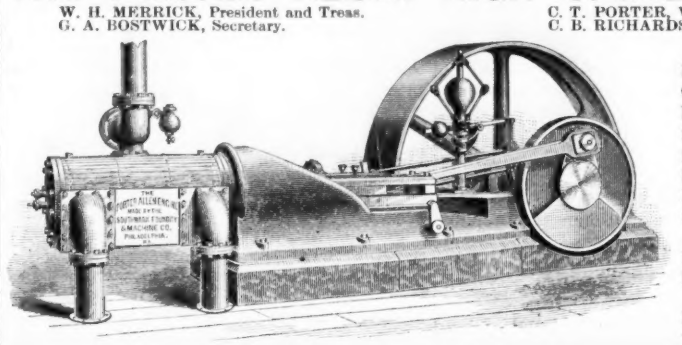

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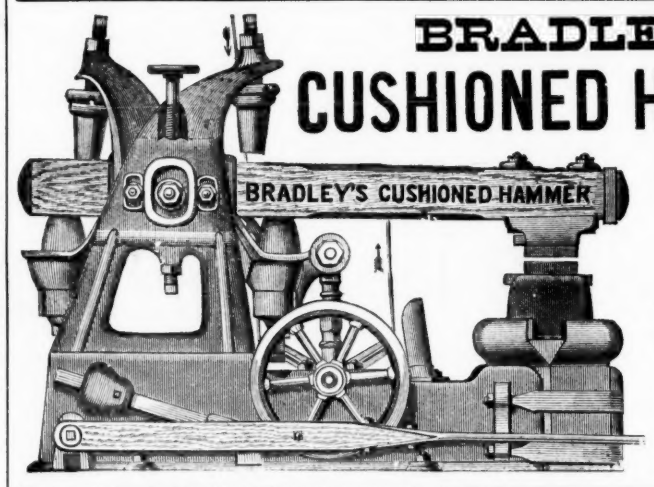

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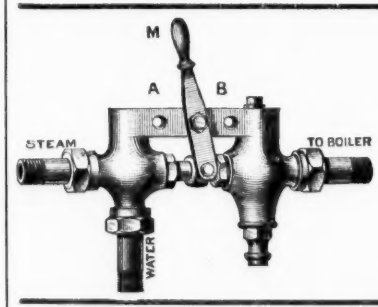

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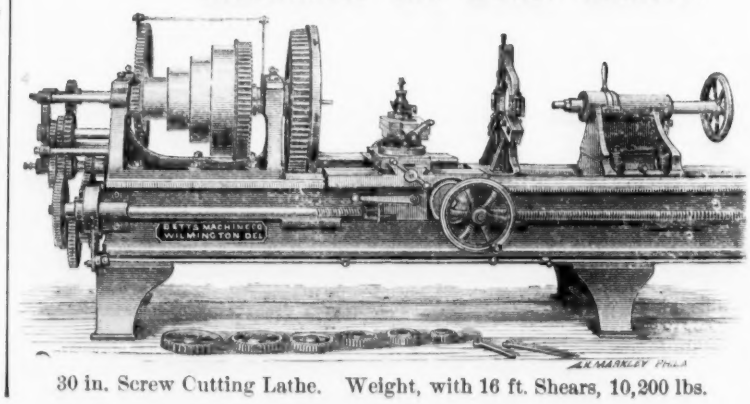

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